

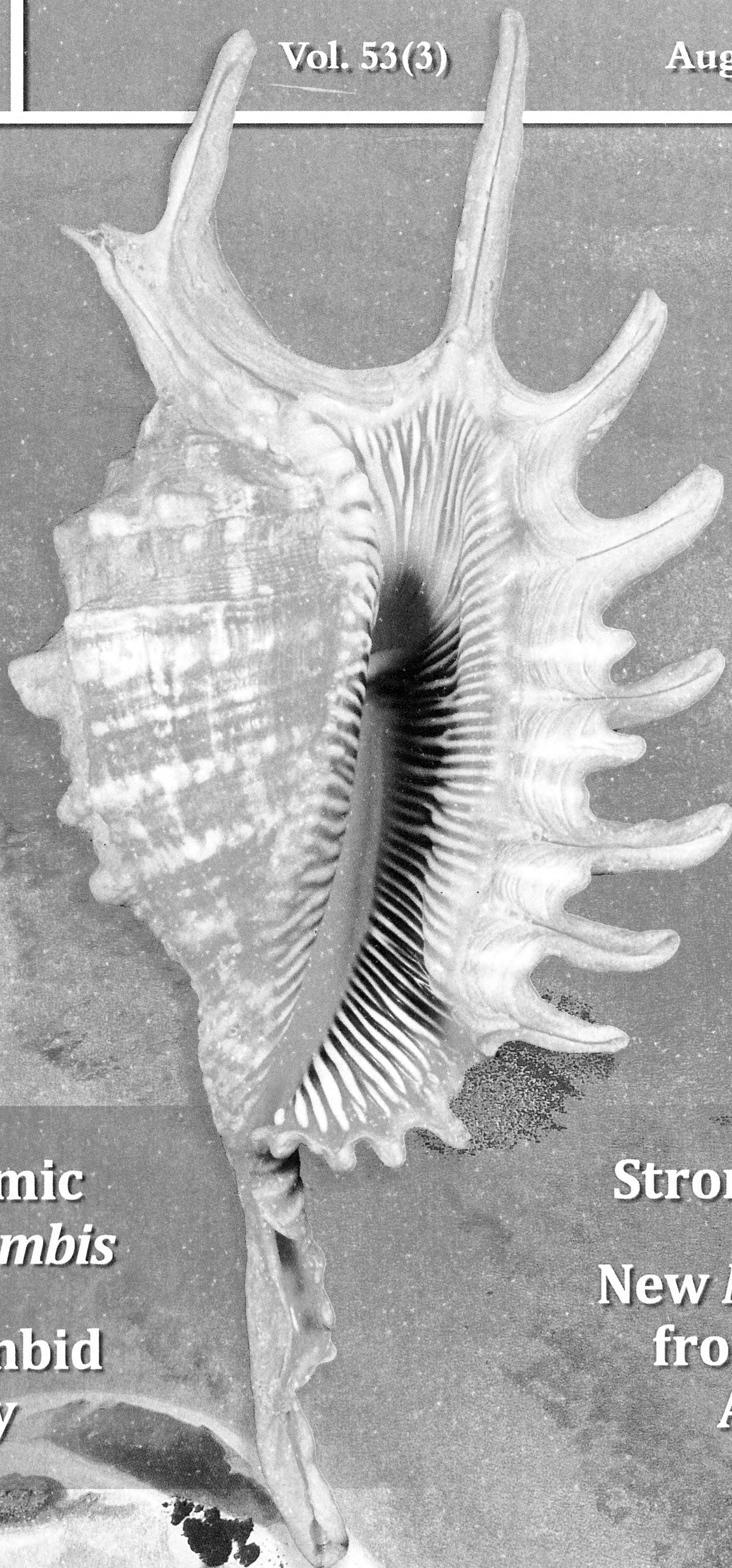
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THE Festivus

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August 2021



A new endemic
Ophioglossolambis
Higher strombid
taxonomy

Strombid eyes
New *Marginella*
from South
Africa

Quarterly Publication of the San Diego Shell Club



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Club meetings are held on the third Thursday or Saturday of the month, except April, September and December, at either 7:30 p.m. in Room 104, Casa del Prado, Balboa Park, San Diego, or at 12:00 noon at other locations as noticed on the Club's website. Due to the pandemic General Meetings for February through April were cancelled and no meeting minutes were recorded.

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FRONT COVER:

Photograph of *Ophioglossolambis itsumiae* n. sp., La Réunion Island, 187.4 mm, Paratype 1, by David Lum. (Cover artistic credit: Rex Stilwill).

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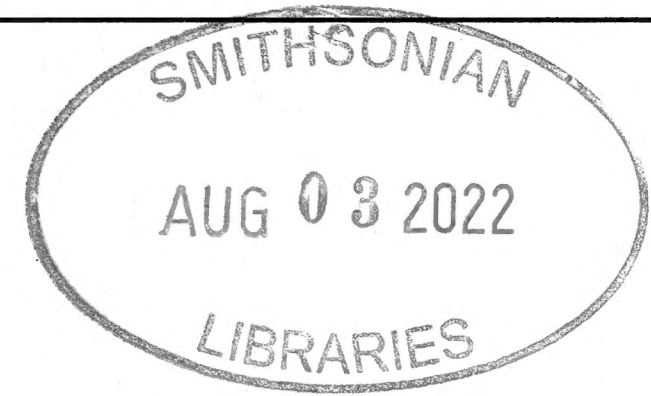
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About abnormalities on the number of eyes and the evolution of the possible eye-sight related shell aspects in Strombidae; introducing new shell terms in Strombidae morphology (Gastropoda: Stromboidea, Strombidae)

Aart M. Dekkers

Oasestraat 79, 1448 NR Purmerend, the Netherlands aart.dekkers@wxs.nl

ABSTRACT Aberrations on the number of eyes and strombid notches, the evolution of the eye-sight, the use of the anterior canal and other morphological adaptations to the shells of the family are discussed. Animals with 3 and 4 eyes instead of 2 eyes are reported just as shells with 2 strombid notches instead of one strombid notch. The use of the term 'siphonal canal' is discouraged and replaced by 'anterior canal'. A new term is introduced: the strombid lobe for the broadly rounded projection on the outer lip posterior to the strombid notch.

KEY WORDS Strombidae, *Strombus*, eyes, eye sight, anterior canal, strombid notch, strombid lobe

INTRODUCTION

Strombidae Rafinesque, 1815 is the largest extant family in the superfamily Stromboidea Rafinesque, 1815, a family of well-known marine snails with many colourful and diversely shaped shells including beautiful shell morphologies. Although the number of species is quite limited (over 100 species at present), the shells are very popular with shell collectors. The family is important as a food source for the human race and is abundantly collected almost everywhere they live, but especially in the Philippines. Recent Strombidae occur exclusively in tropical and subtropical seas, mostly in shallow and very shallow water (Clench & Abbott 1941; Abbott 1960, 1961) while for instance, extant members of the family Aporrhaidae Gray, 1859, also belonging to the Stromboidea, mainly occur in deeper water in subtropical to cold water seas (differences in depth and water temperature).

Most members of the family Strombidae can be recognized by the presence of a so-called 'strombid notch', a sinus of the labrum of the shell through which the second (right) of its two

long eyestalks extends out from the shell (Savazzi, 1991). The first (left) eye-stalk extends out from the sinus at the anterior end of the shell, often wrongly called 'siphonal' canal, which I will explain in this paper. The strombid notch is almost exclusively a Strombidae evolutionary adaption lacking in the other families in the superfamily Stromboidea; the only exception being members of the Rimellidae Stewart, 1927. For example, *Varicospira decussata* (Basterot, 1825) from the Miocene of Dax, Landes Department, France, has a perfect strombid notch (Plate 2A, C). Also living members such as *Varicospira cancellata* (Lamarck, 1816), a well-known species from the Philippines, and *Varicospira crispata* (Sowerby, 1842) have a clear strombid notch (Plate 2B, D). The other members of the family Rostellariidae Gabb, 1868 (and the Seraphidae Gray, 1853) did not develop a true strombid notch but have long eye stalks. A photo of the live *Terebellum terebellum* (Linnaeus, 1758) from Guam (Courtesy of Bob Abela) is shown (Plate 3D), along with an empty shell from the Philippines showing the lack of a strombid notch (Plate 3A).

Eyes are located at the end of the long eye stalks of the strombid species. The eyes themselves are almost human at first sight: a central dark coloured spot with one or more differently colored circles including white around this central spot. When the eyes are focused on the viewer, it almost feels like you are being spied on (just look at photos of live animals). What the affected animal is likely to see is not yet known. It can be black and white, just shades, but colors can also be the case. This can be a subject of further (scientific) study, and the London museum is working on this aspect (personal communication).

Members of all other families included in Stromboidea have not developed a strombid notch in the evolutionary path, though evolutionary trends towards this phenomenon can be observed. For example, the recent members of Aporrhaidae have the head between the first and the second digitation like *Aporrhais pespelecani* (Linnaeus, 1758) and *Tibia* species such as *Tibia insulaechorab* Röding, 1798 (Rostellariidae) have protective spines on the apertural rim (Plate 1B and A respectively).

The majority of Strombidae snails are found in fairly shallow waters, often in combination with seagrass species. A lot of them are burrowers in clean sand, coarse sand or muddy sand. Strombids are known to be herbivores or detritivores (Abbott 1960, 1961). It is therefore somewhat surprising that strombids are thought to have excellent vision (due to the peculiar development of eyes on eye stalks). Unlike most mobile "higher Caenogastropoda" (like tonnoideans and Neogastropoda (Simone 2005: 247)), Strombidae do not hunt or prey on other animals. These other Caenogastropoda probably don't use the eyes as a primary agent, but other sensory organs such as smell or vibrations. Why strombids developed eyes on stalks is therefore problematical but is likely not necessary for the

feeding process, but possibly to escape predators.

The shell morphology and the diversity of stromboid gastropods was the subject of the research of Savazzi (1991). Especially the evolution of the shell shape and the snails' way of life was his main interest.

The extreme diversity in shell form of strombid gastropods is interpreted by Savazzi (1991: 311) as the result of three independent factors:

- (1) The terminal growth pattern of the Strombidae allows the circumvention of geometric constraints on shell morphology found in gastropods with continuous or periodic growth patterns;
- (2) Shell morphology in the Strombidae is adaptive to epifaunal locomotion, burrowing, infaunal or semi-infaunal habits and passive protection from predators. Specialization for one of these functions often conflicted with the others, thus bringing about a forced choice among mutually exclusive morphological characters;
- (3) Conservatism in life habits and anatomy of the soft parts has allowed the multiple evolution of extreme shell morphologies, as well as the secondary return to relatively unspecialized morphologies.

Especially factor (2) seems the important driver of the development of eye sight in the evolution of Strombidae.

One of the very remarkable facts on Stromboidea is that the soft parts between the recognised families in the superfamily do not vary much (Jung 1974). Perhaps this is due to the simple diet of the snails, which originates the successful basis scheme of organs of the snails, fit for a long period of time involved in the evolution that led to the diversification into families of which only a few are still extant.

Instead of altering the basis scheme of organs, the snails are highly adaptive to the environment or habitat, which resulted in a multitude of shell forms.

METHODS

The discovery of strombid shells with double strombid notches (coll. AMD) and photos of live animals with more than 2 eyes were the trigger for this study. Shell aspects of Strombid shells are discussed based on personal observations and related to literature directly or indirectly involved with 'Eyes on Stalks' unique development within Gastropoda within the superfamily. Evolutionary paths of these aspects are discussed where possible within the scope and the general knowledge.

ABBREVIATIONS

AMD = Collection of Aarl M. Dekkers, Purmeiend, the Netherlands.

MNHN = Musée National d' Histoire Naturelle, Paris, France.

TERMINAL GROWTH

Almost all Strombidae – and the species in the other families in the superfamily – are characterized by terminal (or determinate) growth. After the shell attains the adult size the aperture undertakes a change in shape. The adult conch lip is often flared or wing-shaped. Shell secretion is subsequently restricted to selective thickening of the interior of the shell and thickening of the wing and apertural rim. Projecting teeth or digitations are formed in certain clades and species at the edge of the shell lip. Shell secretion stops completely or continues very slowly with the deposition of semi-transparent callus on some parts of the ventral surfaces. In older snails the thick parietal callus and the callus on the outer lip sometimes

gets a silvery or purple-blackish hue. This is especially seen in species without projections on the outer lip, like members of *Laevistrombus* Abbott, 1960. The digitations on the outer lip are an interesting and attractive aspects of Strombidae. In the process of terminal growth, the formation of the labrum (the wing), the strombid notch is also formed. Before this final stage, the shell has a more or less conoidal form with a thin lip, almost mimicking a *Conus* shell.

DIGITATIONS

Spines are initially built as folded digitations of the outer lip in species of *Lambis* Röding, 1798. Extensions of the mantle occupy the interior of the spines, and progressively fill them with shell material. Once the spines are completely filled, the mantle retracts within the shell aperture, leaving a slit-shaped scar along the ventral surface of the spines. This is especially well visible with the members of the genus *Lambis* and related genera Like *Ophioglossolambis* Dekkers, 2012 and *Harpago* Mörch, 1852 with large digitations.

In many species in other genera, outer lip thickening occurs in adulthood without large spines developing. In the shells of these species, bumps are often visible where the strong ribs of the body whorl end at the outer lip. This was also noted by Vermeij (2014: 329) but not exclusively for Strombidae members. “Ventrally directed serrations, lobes or spines occur in many Indo-West Pacific stromboidians. In *Tibia*, blunt spines associated with obsolete spiral cords are oriented ventrally at the edge of the adult outer lip”. These ‘obsolete spiral cords’ can be seen in the shell of *Tibia* species by the lighter coloured spiral banding. More directly it is seen in the related *Rostellariella delicatula* (Nevill, 1881), which is shown on Plate 1C. These obsolete spiral cords occur also in the stromboidian genera *Tridentarius*

Kronenberg & Vermeij, 2002 and *Terestrombus* Kronenberg & Vermeij, 2002, which are also remarkable by the very minimal strombid notch (on Plate 3B). The strombid notch is thought to be the hallmark of Strombidae, but in these two genera the evolutionary path made it disappear (secondary loss) which may be a consequence of their lifestyle as speedy sand burrowers.

In *Terestrombus terebellatus* (Linnaeus, 1758), 5 white beams can be seen towards the apertural rim, 2 of them besides the shallow strombid notch, resulting in very small rounded dents (Plate 3B). This is also the case in *Tridentarius dentatus* (Linnaeus, 1758) (Plate 3C).

Vermeij noted that in *Tridentarius dentatus* (Linnaeus, 1758) “there are three ventrally directed spines, one anterior to and two behind the strombid notch” hence the chosen name *Tridentarius*. But on closer inspection, there are two more obsolete spirals situated more posteriorly resulting in knobs on the outer lip that did not fully develop into little spines. Most likely all the spiral ribs and obsolete spirals both ending in either spines or bumps are reinforcements of the shells as a protection from predators (new observation). The spines themselves can be important as protection and / or for stabilizing the shell on the surface on which the animal crawls. With Vermeij (2014: 329) I also conclude that these configurations arose independently in several lineages, but with hesitation. Vermeij is limiting it to Strombidae, but it also counts for *Tibia* (Rostellariidae Gabb, 1868). The coding in the DNA of the reinforcements and the spines in Stromboidea is perhaps very old and on/off in the lineages as evolution found it of benefit or due to life habits and perhaps as old as the Harpagodinae Pchelintsev, 1963 (Aporrhaidae). The Harpagodinae members (upper Jurassic - lower Cretaceous) possess angulations, which strengthen the broadly expanded labrum.

Perhaps it is better to state that the configurations originated early in Stromboidea (instead of Strombidae) and switched on or off in the evolution of the clades. Is this an example of Atavism? In biology, an atavism is a modification of a biological structure whereby an ancestral genetic trait reappears after having been lost through evolutionary change in previous generations (definition from Wikipedia). In short, an 'atavism' is an evolutionary throwback to more primitive times. As said, the DNA contains, genomes which serve as archives of the evolutionary past in whatever lineage. It only has to be turned “on” again, for whatever reason, in the evolution.

We have found no evidence of a link between the evolutionary development of digitization and the evolution of vision and long eye stalks in Strombidae in literature.

The development of strong cords resulting in digitations is not limited to Stromboidea. A remarkable radiation of gigantic early Cypraeidae in the Eocene of western Europe (Dominici *et al.* 2020) also show this almost unique feature. These gigantic Eocene fossil cypraeid species showing strong dorsal ridges and spines as prolongation of ridges. No dents along the aperture as commonly seen in present day cypraeids. Shells resembling a *Lambis* species. Shown here (Plate 4A-D) are the newly described species *Vicetia bizzottoi* Dominici, Fornasiero & Giusberti, 2020. There are several other species from the European Eocene (England, France, Spain and Italy) in the genera *Vicetia* and *Gisortia*. *Gisortia coombii* (Sowerby in Dixon, 1850) is also such rare dream fossil shell, with flower-like spines, but no ridges to reinforce the shell (Pacaud, 2008). Another species is *Vicetia hantkeni* (Lefevre, 1878) also on Plate 4E. The development in these gigantic cowries and the later evolved strombid species are analogous. The ridges,

reinforcements and spines in strombids are not modified versions of a structure present in a common ancestor with cowries but probably have developed independently as adaptations to a likewise shared habitat, probably off shore and rather soft substrate, not seen in any other group of gastropods.

Examples of all kind of strombid notches are on the Plates 5 and 6. The shallow strombid notches in the big American strombs are exemplary for the huge species crawling on the sandy surface soil (Plate 5). *Macrostrombus costatus* (Gmelin, 1791) and *Titanostrombus goliath* (Schröter, 1805) are illustrated: not more than 9 mm on a shell of 310 mm large! The smaller (but still medium size to large) species on Plate 6 show us deeper incised strombid notches: smaller and deeper. These species are all in the same subfamily of the Strombidae: the Strombinae Rafinesque, 1815. Exception is *Mirabilistrombus listeri* (Gray, 1852), which has a very wide and deep strombid notch. This species is in the other subfamily Carininae Dekkers, 2008. Dekkers (2008) named these groupings as tribes in this work, but the definitions given there are herein supported as subfamilies. Carininae - definition: includes all smaller forms of the family Strombidae. Shells are small to medium sized, often decorated with small knobs on the shoulder and mostly decorated on the body whorl with axial ribbing, strombid notch shallow to clearly visible; lip thickened sometimes on the inside and sometimes on the outside, sometimes flaring and sometimes not so flaring, columella and inside of lip often decorated with lizae or teeth. Type genus: *Canarium* Schumacher, 1817. In the tree in Latiolais *et al.* 2006, the 2-split in the branches are seen and supported by molecular comparison.

A real eye-opener is the size and form of the strombid notch compared to the size and form of the sinus (=opening) of the anal canal. A good observer can detect the logical build of these two structures in a strombid shell: look at the shell at the anterior end and level the labrum horizontally. Then you will notice that the strombid notch is in line with the anal canal in height and in form. This has not been posted previously, to my awareness.

STROMBID LOBE

In the stage of adulthood an indentation, called stromboid notch, is often found along the lateral margin of the adult wing, rather anteriorly. Also, in most of the larger extant Strombidae, there is a kind of curtain or flap between the strombid notch and the anterior canal. I have not found a name in the literature for this special strombid shell function and suggest calling it '**strombid lobe**'. Basically, I found that there are two types of strombid lobes: fairly large lobes that are vertically oriented and a second group with lobes that are quite small and follow the outline of the labrum. Genera that have shells with a large, down pointed strombid lobe are: *Harpago* Mörch, 1852; *Lambis* Röding, 1798; *Lentigo* Jousseaume, 1886; *Ophioglossolambis* Dekkers, 2012; *Solidistrombus* Dekkers, 2008 (not available 'synonym' *Sinuistrombus* Bandel, 2007) and *Tricornis* Jousseaume, 1886. These are the larger shelled Indo-Pacific species and genera. Examples of these strombid lobes are shown on Plate 6C, D, and F with *Tricornis tricornis* ([Lightfoot], 1796), *Lambis lambis* (Linnaeus, 1758), *Lentigo lentiginosus* (Linnaeus, 1758) and *Solidistrombus sinuatus* showing the strombid lobe with the down pointed fingers (=ribbing). The smaller shelled Indo-Pacific genera mostly have the smaller type of strombid lobe. Curiously, the huge species in the American radiations have the smaller kind of strombid lobe or even lacking

just as the strombid notches are hardly present; see *Titanostrombus goliath* (Schröter, 1805) (Plate 5A-C). Perhaps these differences can be linked to be evolutionary aspects of the animals. I have noticed that many of the smaller types are sand burrows and it is likely that a small strombid lobe aligned with the outer lip is an advantage when digging into the sediment. The larger shelled Indo-Pacific genera with shells with a large, downward facing strombid lobe are usually crawlers on the sediment instead of burrowers and then a larger lobe is an advantage as it provides better protection for the weak parts of the animal and especially the vulnerable eyestalks. The smaller type of strombid lobe also offers protection to the animal but in a lesser degree, which is not a real disadvantage when buried in the sediment. The conclusion is that the strombid lobe offers protection to the weak parts of the animals and especially the eyestalks. It is related to the living habits of the species.

Note that the strombid lobe is only formed in adult shells; the juvenile shells have a straight thin ending of the aperture. Shells of Strombidae remain thin walled throughout the late juvenile, immature and subadult stages. The adult wing is initially built as a very thin and fragile membrane that gradually becomes thickened on its internal, ventral, surfaces. Secondary thickening may also take place on parts of the internal and external (ventral) surfaces. This results in a remarkable increase in shell weight: the shell can be more than doubled or tripled in weight (Savazzi 1991: 314) from the almost adult to fully adult stage. Only in this adult stage the labrum is fully formed with a strombid notch (not in all species), strombid lobe and digitations in some species.

THE SNOOT

The head of the gastropods can have one of 3 major varieties for consuming the desired food. The simplest one is just a plain head without any elongated parts. One of the more successful varieties, the proboscis, is a feature developed in the higher evolutionary lineages in Gastropods. The highly developed proboscis is (partly) retractable. This kind developed in the higher Caenogastropoda starting with Calyptraeoidea and including all following superfamilies including Naticoidea, Cypraeoidea, Tonnoidea and Neogastropoda (Simone 2019: 28). In Strombidae a proboscis has not yet developed, but instead the elongated snout has already a retractor muscle (Simone 2019). The Strombidae seems to be a first step in the development of the proboscis in Gastropods. It makes it easier for the animals to get the food while buried in the sand for the burying species or in the crawling mode of the larger species. The development of the retractable snout is seemingly not related to the evolution of the eye-sight. I place this development in the context of the mobility and lifestyle of the animals.

THE DEVELOPMENT OF THE ANTERIOR CANAL

Gastropods in which the siphonate condition arose were mobile, bottom-dwelling, microphagous animals (Vermeij, 2007: 469). According to Vermeij, conservative estimates indicate that the siphonate condition arose the incredible number of 23 times (and were secondarily lost again 17 times). Active predatory habits became associated with the siphonate condition in for instance many members of the Neogastropoda.

Many infaunal predatory gastropods have a short (though often very deeply notched)

siphonal canal through which a very long proboscis emerges. Wide, deep siphonal notches and dorsally deflected canals offer great flexibility to the siphon and proboscis, and may enable the gastropod to detect dangers and opportunities of importance above as well as ahead of the snail (Vermeij, 2007: 474). The siphonal canal in most living siphonate gastropods is associated with organs that produce a narrow anterior inhalant current of water. Associated sensory organs detect both the concentration and direction of chemical cues released by distant food, enemies, or mates (Vermeij, 2007: 473, Lindberg and Ponder 2001). Inhalant streams in non-siphonate gastropods are more diffuse, meaning that ventilation of the mantle cavity is controlled passively or actively by other structures than a siphon. Among the extant siphonate snails are the 'higher Caenogastropoda': cerithioideans, campaniloideans, and stromboideans. These are however either herbivorous or microphagous and not predatory snails. Simone (2001) has shown that the siphonal canal of cerithioideans is not associated with a fully differentiated siphon (Vermeij, 2007:474). Also, a developed siphon is lacking in Strombidae (Plate 8C, *Macrostrombus costatus* (Gmelin, 1791) aquarium photo); only a simple mantle flap is present.

The anterior channel in strombid species is commonly referred to as the 'siphonal canal' which is an obvious misunderstanding as the shell structure is not used by the animal for a siphon, but is instead used to protrude the left eye stalk. This is a remarkable invention in the gastropod lineages and truly unique. There is not one other gastropod family that uses the 'siphonal canal' for one of the eye stalks. Here we see the evolution of two sinuses used for the eyes: the anterior channel (or canal) and the strombid notch. Members of the closely related family Seraphidae have not developed a

strombid notch, but recent members of this family use the broad anterior end of the shell to accommodate both eye-stalks. Here the shell is adjusted in a different way, likely facilitating the protection of the head of the animals with a broad roof and a broad 'window' for the eye-stalks, retaining a very smooth torpedo like form for fast moving in the sand. Same intention, different solution. This 'hooded' protection is also found in some genera of the family Ovulidae (personal observation) where the animals use the extension of the shell as a kind of hood. This observation is in line with that of Vermeij: "a long siphonal canal extends the shell's passive defence by shielding the vulnerable anterior organs from above and below while the gastropod is active" (Vermeij, 2007: 474).

According to Vermeij (2007: table 1) the siphonate character arose already in the Early Jurassic (Toarcian) in Stromboidea. The family of the aporrhoids, a basal family in the Stromboidea, have been siphonate since their first appearance in the Early Jurassic, though it is not very easy to see: it is just the broad sinus between the 2 front spines.

All early representatives of siphonate gastropod groups appear to have been microphagous (Stanley 1977), as are living cerithioideans and stromboideans, which also have high-spired siphonate shells. Predatory habits of tonnoideans and neogastropods have been possibly the triggers for the evolution of the proboscis and associated organs of the digestive system (Kantor 1990, 1996; Riedel 2000) and the further use and development of the siphonal canal in these lineages. The 'bauplan' was already invented in the early roots of gastropod evolution. But the question is why the early siphonate condition arose.

The (early) siphonal condition (cerithioideans, campaniloideans, and stromboideans) seems to be linked with active crawling animals on a sand/mud bottom, which have a shell form that enables the animals to crawl easily and thus fast. It probably evolved as the front end of the shell in conjunction with the strong spiral (coiling) and elongated shell shape. Active predatory animals evolved later and started using the existing '*bauplan*' of the anterior canal with the development of a siphon which was well protected by the existing anterior (now truly siphonal) canal. More sessile snails (an older '*bauplan*') as patellids and trochids are non-siphonate and have a big flat base of the shell or a more or less rounded aperture, for better fixture on the hard underground where they crawl slowly. Conclusion: the (early) anterior ('siphonal') bearing shelled snails are either herbivorous or microphagous and not predatory, thus the development of an anterior canal is not (directly) linked with the feeding habits. The remaining logic beneficiary lies in the assumption that it is the result of the development of fast locomotion and the assumption of Vermeij that it has evolved for the benefit of protection. For the head and the organs there placed, including the eyes. I herewith like to discourage such an ingrained term as "siphonal canal" and replace it by the term "anterior canal" for Strombidae and Cerithidae. I hope subsequent authors will do the same.

DEVELOPMENT OF THE STROMBID NOTCH

The strombid notch is, as said, a development uniquely in Stromboidea (Strombidae and Rimellidae) and all other known gastropods lack this feature on the anterior part of the edge of the labrum. The strombid notch can be rather shallow or deeply incised into the labrum, differentiated on the species or genus, as

discussed before and shown on Plates 5 and 6. Kollmann (2005) allocated the subfamily Harpagodinae to the family Strombidae on the basis of the basal notch. Due to the presence of an identical small basal notch in the Aporrhaidae, he later (Kollmann 2009) placed the Harpagodinae in the family Aporrhaidae. Perhaps the origin of the strombid notch is already as early as the Mesozoic era.

As the location of the strombid notch is on the labrum at the anterior part, the right side of the animal, one eye is pointing sideways to the right, leaving the left side of the animal unwatched. However, watching movements of strombid species (personal observations), the animal moves in a straight line using both eyes in forward direction, thus the head is not in line with the apex of the shell, but instead the shell is oblique compared to the head. It seems that 2 eyes through the anterior canal is more logical to us (as in *Terebellum*, Seraphsidae) but apparently there are better evolutionary arguments for the evolution of the strombid notch. One argument could be that the smaller anterior canal is a better protection against predators like crabs and the shell can be smaller constructed as part of the head is protected by the labrum. In the adult stage the mantle just has to skip a part of the reinforcing of the labrum to create the strombid notch. This seems to be an easy adaption, which renders a safe condition and the possibility to peep out under the roof of the labrum. Thus, also an evolutionary trend for the benefit of safety in combination with the development of the eyes and the unique development of long eyestalks. The Seraphidae have developed a torpedo like shell which enables them to move with high speed through the clean sand. They lost the broad shell form as in Strombidae in favour of speed and thus did not develop a strombid notch for the long eyestalks.

The Rimellidae arose in early Eocene and already demonstrated strombid notches (in *Ectinochilus* Cossmann, 1889; *Dientomochilus* Cossmann, 1904; *Dasyostoma* Stewart, 1927; *Varicospira* Eames, 1952) in the Eocene period and onwards. In genera of the Strombidae, strombid notches are absent or very obscure in the Eocene (*Oostrombus* Sacco, *Orthaulax* Gabb, 1873). The evolutionary relation between the Rimellidae and the Strombidae is not yet clear.

Early (large) strombids like the very large *Dilatilabrum roegli* (Harzhauser, 2001) from the Chattian (Late Oligocene) of Greece and *Dilatilabrum fortisii* (Brongiart, 1823) from the middle Eocene of Italy lack a strombid notch or have a very shallow indentation but do have the general *bauplan* of the larger extant strombid species. Also, *Dilatilabrum trigonus* (Grateloup, 1834) from the lower Miocene of France still lacks a strombid notch. Even *Tricornis tricornis* (Lightfoot, 1786) from the Pleistocene (Ras Doumeira, Djibouti, Gulf of Aden) of the Arabian Sea has a very shallow strombid notch (personal observation). Only extant *T. Tricornis* of the Egyptian Red Sea have well developed strombid notches. This is also seen in American gigantic strombid species like *Lobatus dominator* (Pilsbry & Johnson, 1917) from the Oligocene up to the upper Miocene of the Caribbean which lacks a strombid notch, even the extant *Titanostrombus goliath* (Schröter, 1805) has only a very shallow strombid notch (Plate 5A-C). These large to gigantic strombid species are likely not burrowers but remain surfaced on the sand and therefore did not develop a strombid notch. The conclusion could be arrived that strombid notches developed primarily in the branches of burrowing strombids and that the very shallow or almost obsolete strombid notches in the large not burrowing species could be secondary loss or the basic situation.

Bandel (2007) also notes that *Dilatilabrum* (for which he erected the new family Dilatilabridae) resemble *Strombus* in shell shape with an expended outer lip but do not have a stromboid notch. As they lived in the Paleogene, he concludes that they may represent the stem group to the Strombidae. Strangely, he places the younger genera *Oostrombus* and *Orthaulax* (Eocene, Oligocene and Miocene), which have smoothed shells with callus covering the spire as seen in *Calyptraphorus* in the family Thersiteidae Savornin, 1915. Perhaps these *Oostrombus* and *Orthaulax* species were the early burrowing representatives of the Strombidae (with smooth shells), but still lacking a strombid notch. *Orthaulax* can be a enlarged version of *Calyptraphorus*. Further study is needed on the relations between those genera.

Whatever the origin of the Strombidae, the stem group consists of shells without strombid notch. And even up to present times the large strombid species that live epifaunal (living on and not in the substrate) lack strombid notches or have very shallow ones and strong and rapid small burrowers as *Tridentarius* Kronenberg & Vermeij, 2002 and *Terestrombus* Kronenberg & Vermeij, 2002 have secondary lost the strombid notch. Just as members of *Terebellum* Röding, 1798 (Seraphidae) with similar life habits do not have a strombid notch (Plate 3A & D).

In the collection of the author, several strombid shells are housed with 2 instead of 1 strombid notch, at least a structure that looks like it, an anomaly not often seen and not previously reported to my knowledge. The question that arises is: (1) is this an occasional anomaly caused by damage to the mantel, the soft tissue that builds the shell, or (2) is the second strombid notch an anomaly to house a third eye-stalk?

On Plate 9 several examples of this abnormality from the authors' collection are shown. It concerns three from the genus *Euprotomus* Gill, 1870 and one from the genus *Lentigo* Jousseaume, 1886, which are likely genetically closely related when molecular tested. Is this a coincidence?

In the case of *Lentigo lentiginosus* STR2728 (Figure 9D), no damage to the shell is visible, thus eliminating the possibility of early damage to the soft tissue due to *e.g.* crab attacks. This is also the case of *E. aurisdianae* STR3079 (Figure 9C) though this example bears extraordinary double shoulder knobs. Both *E.*

bulla (STR1428 and STR2227) (Figure 9B) have a dorsal situation that might point at tissue damage, especially STR2227, with raised dorsal rim which points at an early tissue damage. But ending in the apertural rim as an almost perfect second strombid notch. STR1248 (Figure 9A) has a sharp additional shoulder lacking knobs, ending in the apertural rim with a narrow indentation looking a bit like a second strombid notch, but probably is not.

Whether all those abnormal condition of double strombid notch must be the cause of abnormal eye-stem number or tissue damage is hard to tell from only the empty shells.

Character	Strombidae	Rimellidae	Seraphsidae	Rostellariidae	Aporrhaidae	Struthiolariidae
Long eye-stalks	present	present	present	present	-	-
Open anterior canal	present	present	present	-	-	-
Strombid notch	Present or absent	present	-	-	-	-
Short eye-stalks	-	-	-	-	present	present
First labral digits used to protect the head	-	-	-	present	present	-
Average living depth	shallow	shallow	shallow	Shallow to deep water	Shallow to deep water	shallow

Table 1. Comparison of characters of recent Stromboidian families (Xenophoridae excluded)

DEVELOPMENT OF EYE-STALKS AND DEVELOPMENT OF STROMBID NOTCHES

Except Strombidae, the living species of the stromboidean families Rostellariidae (see *e.g.* figures in Man in 't Veld & Visser, 1998), Seraphidae (see *e.g.* Jung & Abbott, 1967: pl. 319, pl. 321 bottom figure) and Rimellidae (observation Kronenberg, 2013) also have their eyes at the tip of long eye-stalks. Thus, this is a synapomorphy of these families within the Stromboidea, distinguishing them from evolutionary older families as the Aporrhaidae and Struthiolariidae, and suggesting a common ancestor where the longer eye-stalks and apparent same usage of the eyes developed (Maxwell *et al.* 2019, the construction of Epifamilies herein). The occurrence of long

eye-stalks is in relation to the development of a strombid-notch is given in Table 1.

Eye-stalks development is a dominant condition or trigger of strombid notch development in both Strombidae and Rimellidae. Most likely the long eye-stalk is a development that arose as result of animals' burrowing modes, a chance to stay safely under the sand / mud while scanning the area for danger. Strombidae and Rimellidae probably have shared ancestors, and the genus *Calyptraphorus* (at present in the Rostellariidae) can be the one (Kollmann 2009: 59). Kollmann (2009: 60) "The Calyptraphorinae Bandel possess a basal notch. They may have given rise to the Rimellinae and perhaps other Stromboidea with a basal notch, while the Rostellariidae, which generally lack a notch,

have evolved from *Hippochrenes* Montfort". These animals (Calyptraphorinae) were burrowers with a smooth shell with a callus layer over the shell that lived in the Cretaceous, Palaeogene and Eocene after which they became extinct. Shells of this group have a broad sinus next to the small open anterior canal, which can be the basic *bauplan* of the later strombid notch and anterior canal used for the long eye-stalks in Strombidae.

ABNORMALITIES IN THE NUMBER OF EYES

In the normal situation, the number of eyes is always 2, each eye on a separate eye-stalk. It is the normal condition; however, deviations are reported in this document. A Caribbean strombid species with a doubled (twin) eye on a stalk (Kronenberg, 2013) has already been reported. In that case, the eyes stayed together like Siamese twins. On the accompanying photo of "*Strombus lobatus* Linnaeus, 1758" in that report, it is clear that the twin-eyes at the tip of the right eye stalk are smaller than the other normal left eye and that it almost looks a split of one normal eye into 2 'Siamese' eyes.

Anomalies in living creatures are perhaps not even rare, but reports about them are. In the past, all kinds of anomalies were collected and put on alcohol in special collections or even displayed as an attraction (especially when it came to people) at traveling exhibitions. In this paper two species with anomalous number of eyes are reported from Turtle Crossing for both, a sandy plateau with scattered coral heads from 12-14 m on the south of the island of Roatan, Bay Islands, opposite of Honduras mainland. This is a clear and unspoilt area with no pollution or other suspect circumstances (observation of Mickey Charteris, the discoverer). It is therefore unlikely that environmental influences are the cause of the deviations. The two species are

Queen Conch, *Aliger gigas* (Linnaeus, 1758) (Plate 7A) with 4 eyes and the Milk Conch *Macrostrombus costatus* (Gmelin, 1791) (Plate 7B) with 3 eyes.

Special attention is also required for the 4-eyed *Conomurex luhuanus* (Linnaeus, 1758) photographed by Shawn Miller (Plate 8A-B). This snail has a normal left eye-stalk with a normal eye protruding through the anterior canal, and the right eyestalk with three eyes of one has a cleaved stem and two eyes are connected just in the form of Y. The eyes look natural and the size is not much different from normal eyes. Also seen in the photo is the proboscis, which appears to be normal. The strombid notch is wider than normal and also the anterior canal is wider than normal, almost twice the normal size (compared to collection material AMD). Thus, there is a relation between shell aspects and the multiple eyes in this aberrant example.

Also, Stephen Maxwell, Cairns, Queensland, Australia once caught a *C. luhuanus* with an additional eye but that was years ago and the animal was discarded, even without taking photos (personal communication, May 2017). The author discussed the abnormal multiple eyes with Maxwell, but he could not recall if the shell had additional features related to the multiple eyes; the shell is no longer in his collection/possession.

In the authors collection, several strombid shells are housed with 2 strombid notches per shell, as discussed before (Plate 8). This is an anomaly that can be caused by damage to the shell secreting mantle or possibly related to multiple eye-stalks. With empty shells it is not possible to determine the cause of the double strombid notch.

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We express our great thanks to Mickey Charteris, Roatan, Bay Islands, Honduras for making the great photos of the live 3-eyed and 4-eyed *Strombus* examples from Roatan, his home town. The same for excellent photos by Shawn Miller of the live *C. luhuanus*. Without these photos it would be impossible for us to demonstrate the deviations in the number of eyes in Strombidae. Thanks also to Tammy Myers, Ormond Beach, Florida, USA, for the aquarium photo of the Milk Conch. All involved are thanked for permission to use these excellent photos. David Berschauer is thanked for editing, and Stephen Maxwell, Cairns, Australia, is thanked for mounting the photographic plates.

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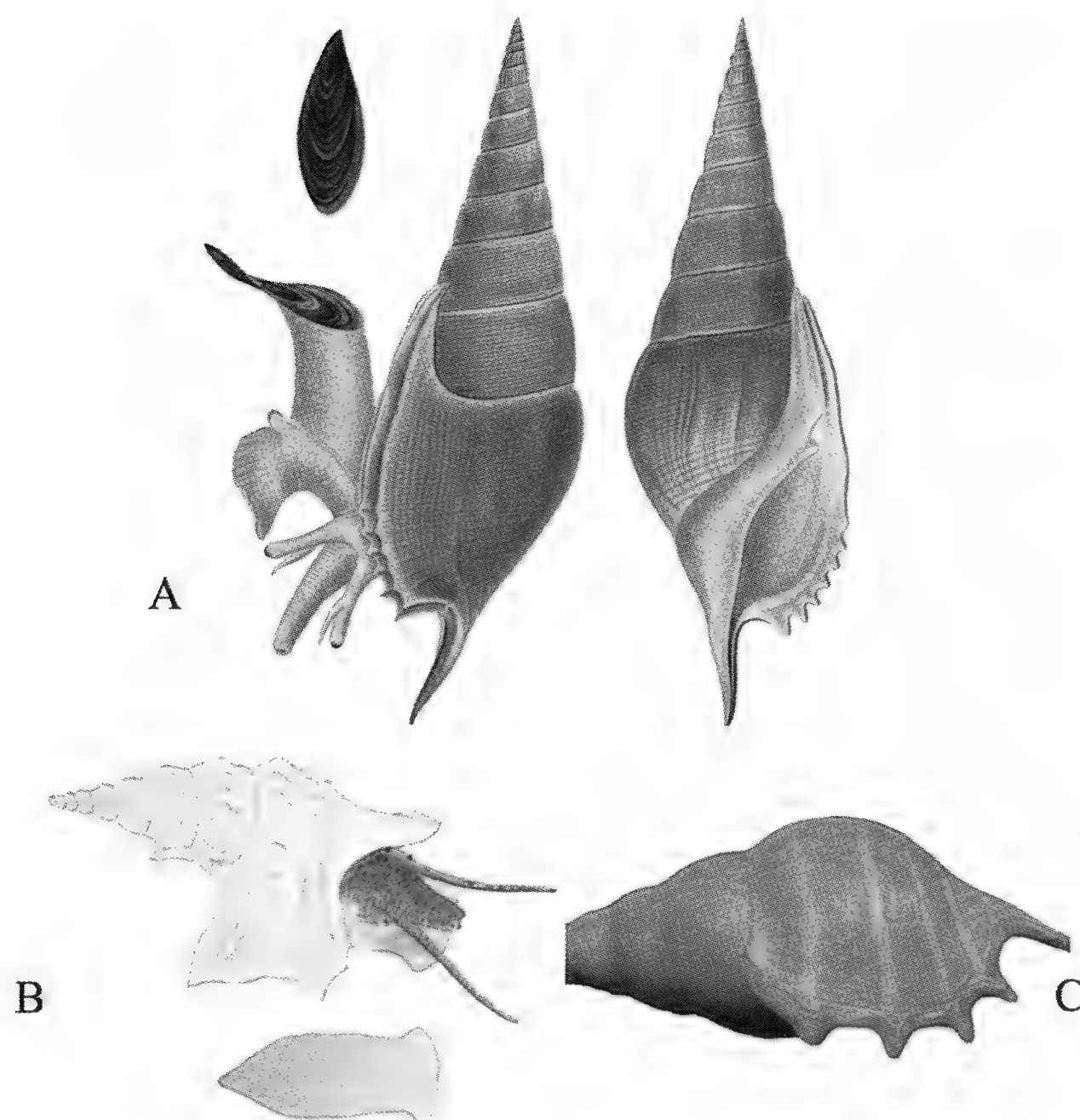


Plate 1. Rostellariidae and Aporrhaidae

A = *Tibia insulaechorab* Röding, 1798 (as *Rostellaria curvirostris*) in Kiener, 1843, Vol. 4, Rostellaria pl. 1, fig. 1. Drawing showing the live animal with the eyes on stalks. Large sinus near the anterior spine for the snout and lacking a stromboid notch.

B = *Aporrhais pespelecani* (Linnaeus, 1758) in Forbes & Hanley, 1853, pl. II, fig. 3, 3a (as *Aporrhais pes-pelecani*). Animal showing eyes close to the body mass, no stalks. A large sinus for the snout and lacking a stromboid notch.

C = *Rostellariella delicatula* (Nevill, 1881); AMD STR0996, Andaman Sea, southern Thailand, trawled by Thai boats, deep water, 1977. Part of the shell showing the 'internal' white bands reinforcement structures resulting in the labral spines.

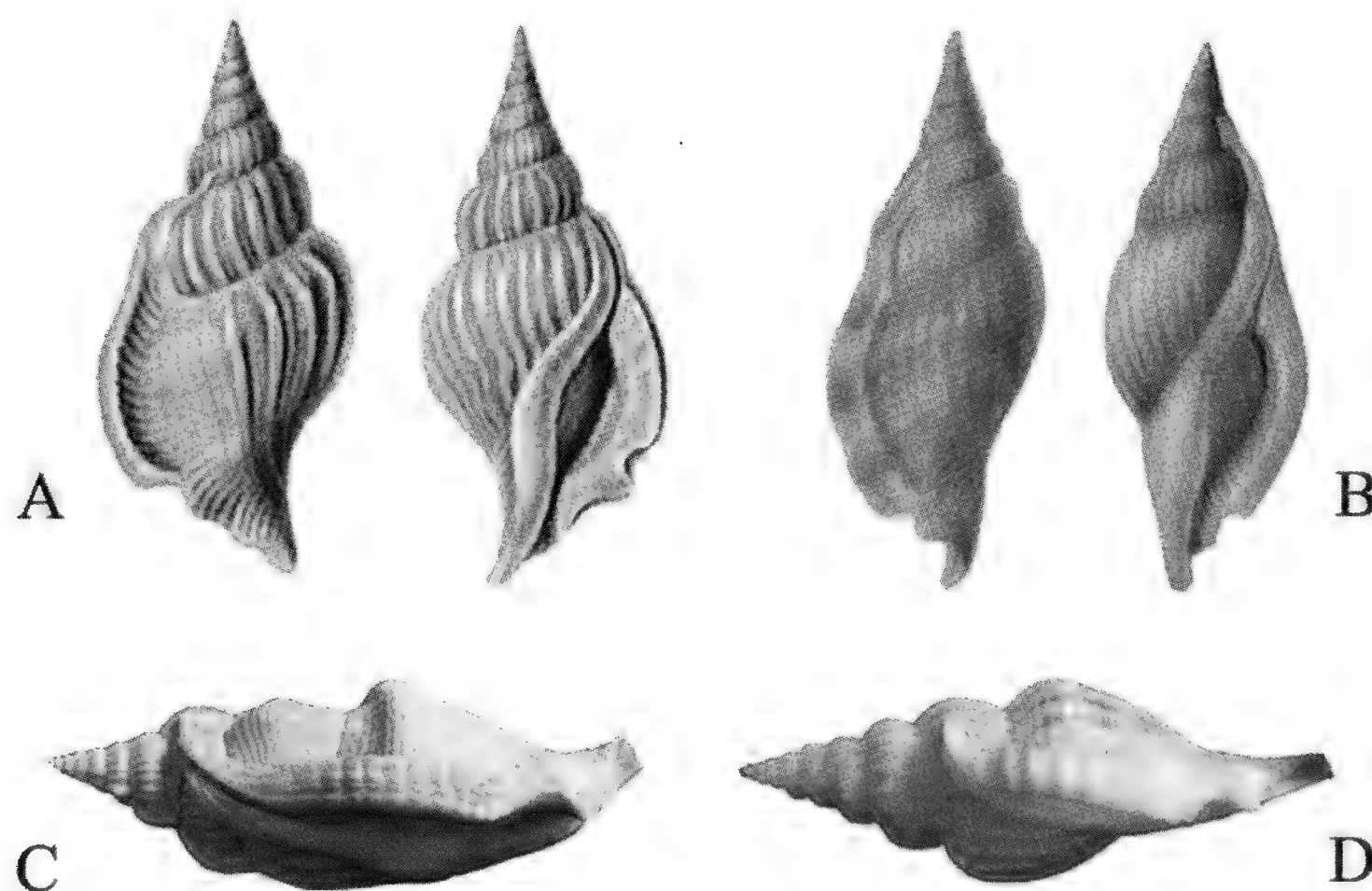


Plate 2. Rimellidae

A = *Varicospira decussata* (Basterot, 1825) in Duclos in Chenu, 1844, pl. ?, fig. 5, 6 (as *Strombus decussatus*). Drawing showing a clear stromboid notch.

B = *Varicospira crispata* (Sowerby, 1842) in Duclos, 1844, pl. 16, fig. 9, 10 (as *Strombus crispatus*). Drawing showing the small but well visible stromboid notch.

C = *Varicospira decussata* (Basterot, 1825), AMDSTR927. H 26 mm. St. Martin d'Oney, France. Self-collected. Miocene – Aquitanien. Clear stromboid notch.

D = *Varicospira crispata* (Sowerby, 1842), AMD1329. H 22.2 mm. Bohol, Philippines, showing the stromboid notch.



Plate 3. Seraphidae and smooth Strombidae

A = *Terebellum terebellum* (Linnaeus, 1758); AMD STR3532, H37.5 mm. Olango Island, Philippines, night dive 20-25 meter. Shell side view showing the lack of strombid notch.

B = *Terestrombus terebellatus* (Linnaeus, 1758); AMD STR3867, H47.4 mm. Calituban Island, Philippines, from fisherman. November 2006. Side view of the shell. Towards the apertural rim 5 white beams can be seen, 2 of them besides the shallow strombid notch, resulting in very small rounded dents.

C = *Tridentarius dentatus* (Linnaeus, 1758); H51.2 mm. Quezon Baraguy, Puring, Palawan, Philippines. Taken in coral sand at 1-3 meters. 09-2006. Clearly seen are the 3 dents and another 3 bumps on the apertural rim connected with 5 white banding. Also the indentation between the first 2 dents serve as shallow strombid notch. Also, the anterior canal is open towards the first 2 dents, both ready for the eye-stalks.

D = *Terebellum terebellum* (Linnaeus, 1758); ~80 ft, Agat Bay, Guam; ~2003-2004; aquarium photo Bob Abela, Guam. Eyes on stalks looking backwards.

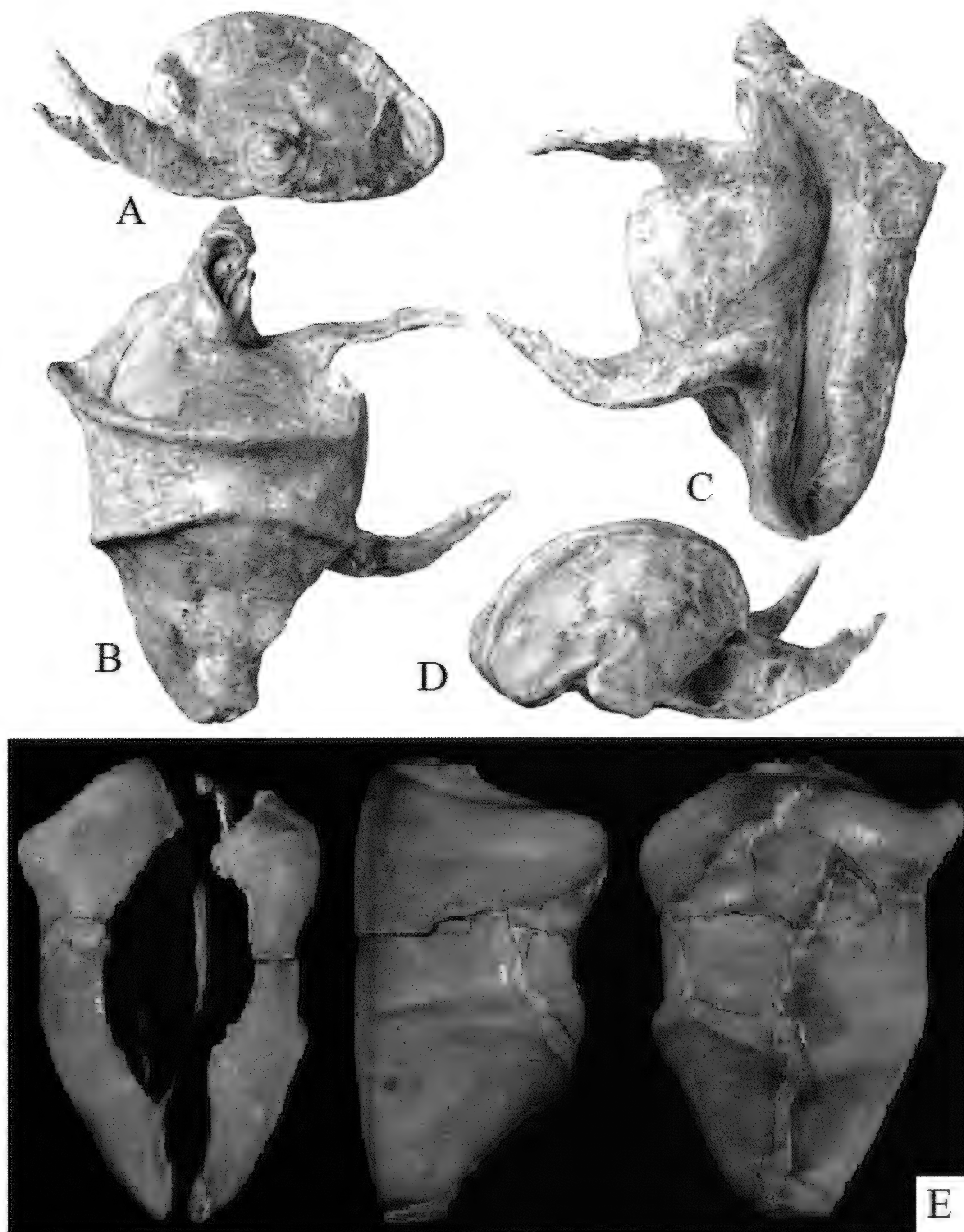


Plate 4. Eocene gigantic Cypraeidae

A to D = *Vicetia bizzottoi* Dominici, Fornasiero & Giusberti, 2020. (Holotype MGP-PD 32314, measuring 335 mm in length). (a) Posterior view, (b) ventral view, (c) dorsal view, (d) anterior view. Gigantic Eocene fossil cypraeid species showing strong dorsal ridges and spines as prolongation of ridges. No dents along the aperture as commonly seen in present day cypraeids. Shell resembling a *Lambis* species.

E = *Vicetia hantkeni* (Lefevre, 1878). MNHN.F.R11785. Specimen with dorsal ridges, measuring approximately 120 mm in length. Gan, La Tuilerie, France. Collected by Didier Merle. Photo Credit: RECOLNAT (ANR-11-INBS-0004), Jocelyn Falconnet, 2017.

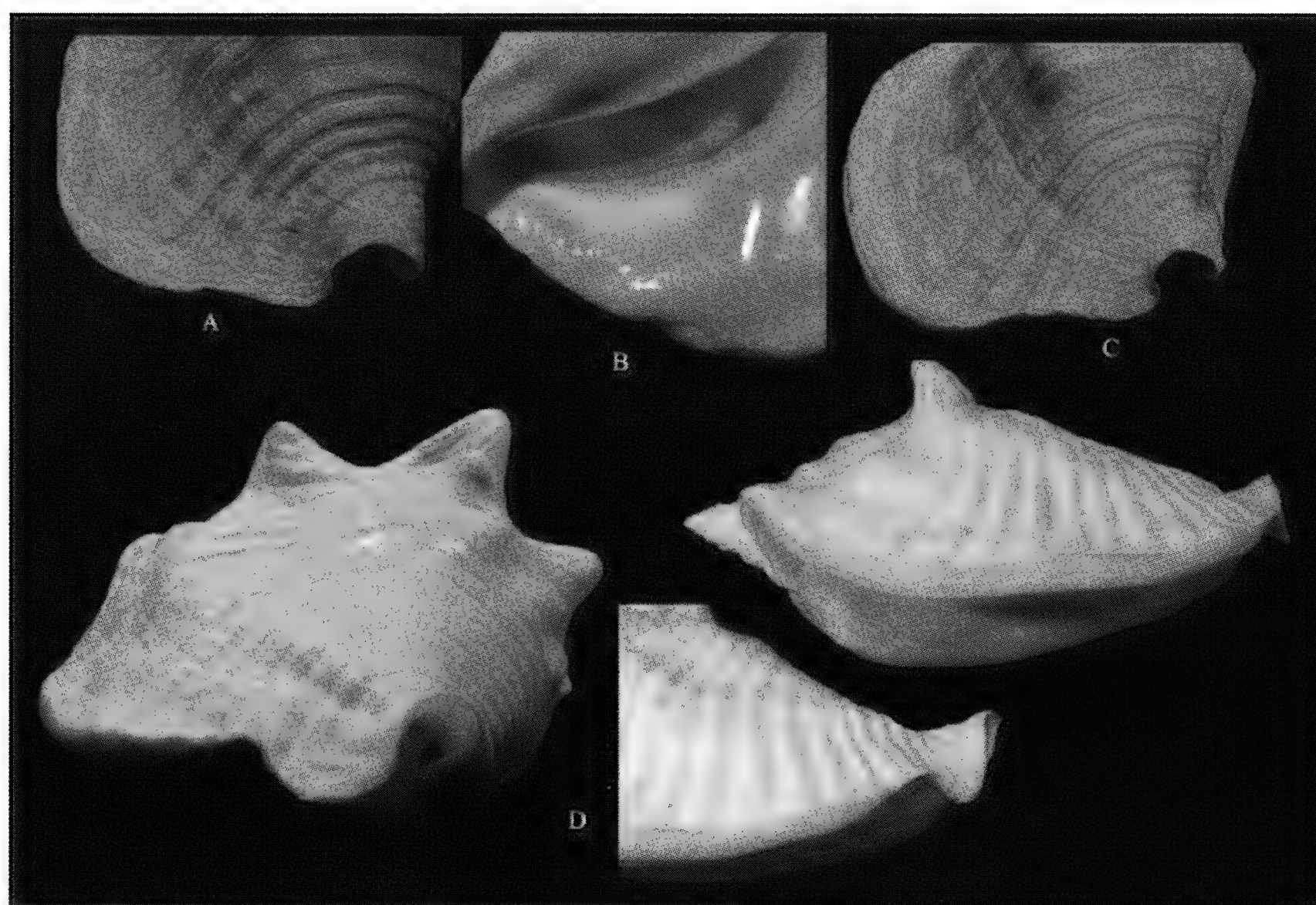


Plate 5. Big Strombidae with shallow strombid notch

A-C = *Titanostrombus goliath* (Schröter, 1805); AMD STR3409. H 235 mm. Recife, Brasil, 2000. Depth of the strombid notch ca. 5 mm of this almost fully adult (not yet thickened lip).

D = *Macrostrombus costatus* (Gmelin, 1791); AMD STR0379. H 187 mm. Photos showing the very shallow strombid notch.

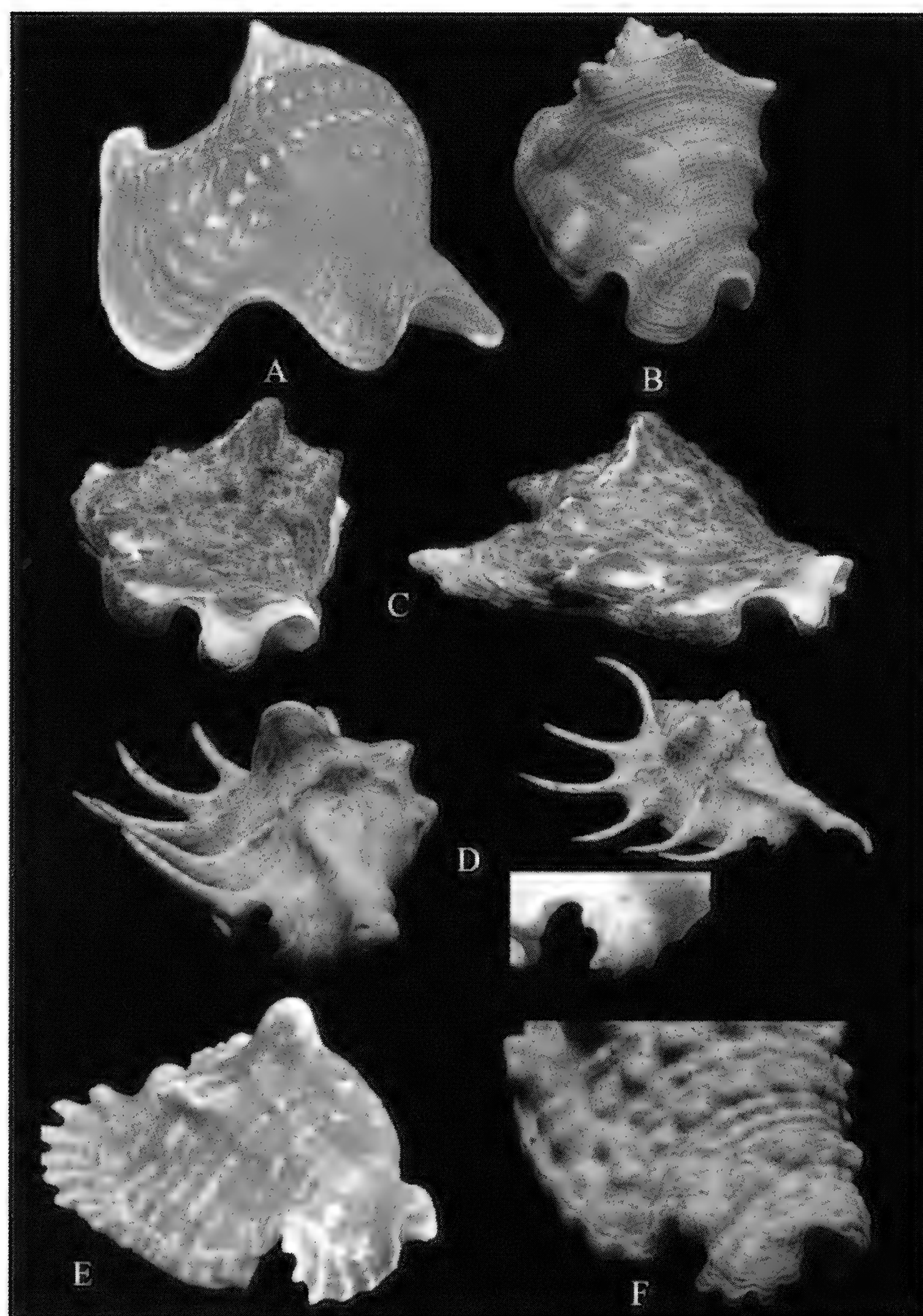


Plate 6. Strombidae with deep strombid notch or large strombid lobe

A = *Mirabilistrombus listeri* (Gray, 1852); AMD STR0573. H 144 mm. Ranong, SW Thailand. Enormous broad and deep strombid notch.

B = *Persististrombus granulatus* (Swainson, 1822); AMD STR1275. H 61.1 mm. La Mira, Las Perlas Islands, Panama, on hard sand flats. Bigg and deep strombid notch.

C = *Tricornis tricornis* ([Lightfoot], 1786); AMD STR3498. H 68.9 mm. Coll. by B. Gras, Mah Kabi, Yemen, Red Sea. With periostracm. Very big and deep strombid notch.

D = *Lambis lambis* (Linnaeus, 1758); AMD STR2242. H 152 mm. Pandanan Island, Philippines. Large strombid lobe with 5 fingers of which one is in the large and deep strombid notch.

E = *Solidistrombus sinuatus* ([Lightfoot], 1786); AMD STR1860. H 86.1 mm. Caubyan Island, Philippines. Strombus lobe with at least 5 downward fingers. Strombus notch also with dents, very deep.

F = *Lentigo lentiginosus* (Linnaeus, 1758); AMD STR3555. H 80 mm. South of Mombassa, Kenya, at 2 meter on sand in algae field. Strombid lobe with 4 downward fingers.

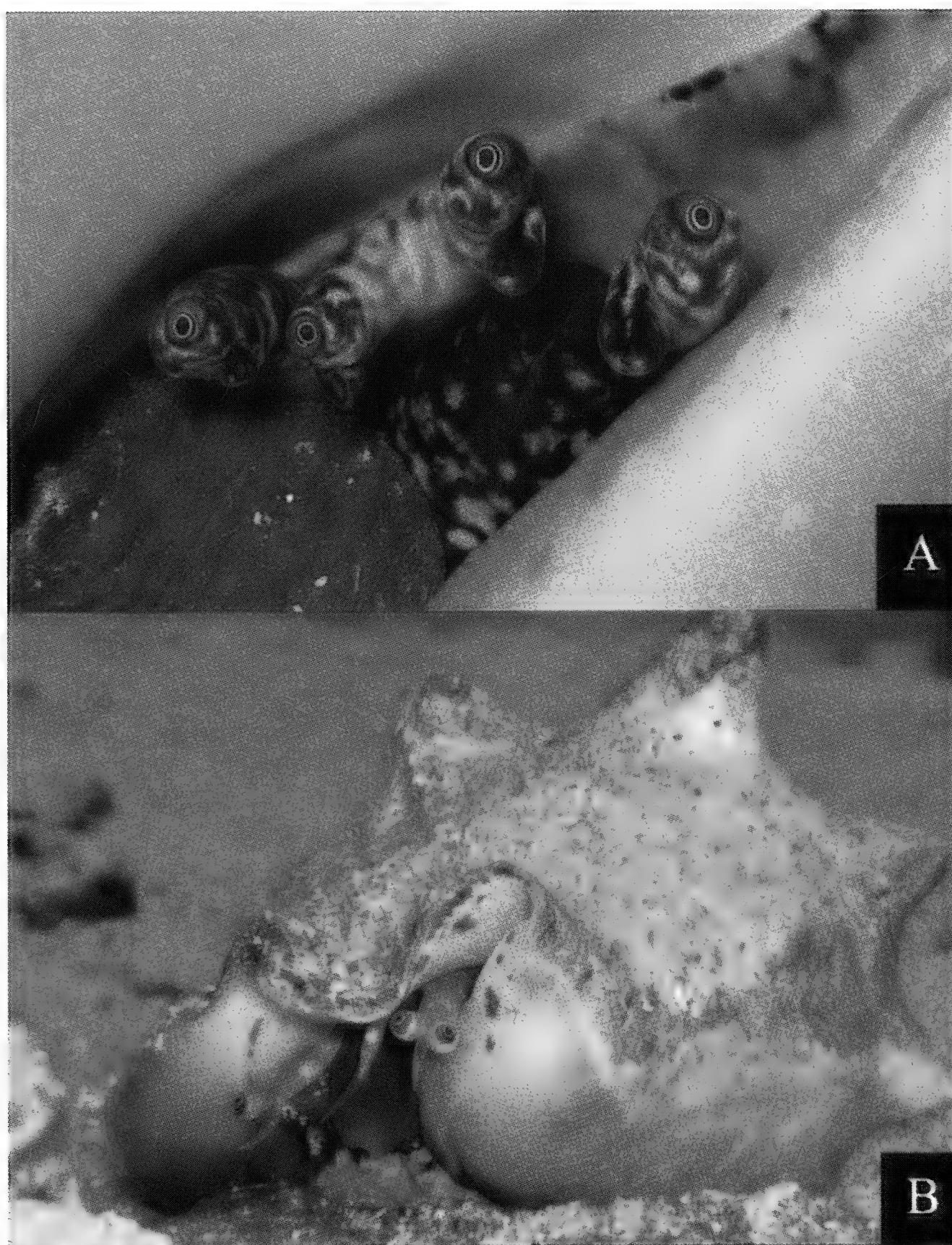


Plate 7. Certain Strombids displaying bifurcated eye stalks

A = *Aliger gigas* (Linnaeus, 1758) with 4 eyes. Turtle Crossing, which is a sandy plateau with scattered coral heads from 12-14-meter-deep on the south of the island of Roatán, Bay Islands, opposite of Honduras mainland, Honduras. Photo courtesy of Mickey Charteris (Caribbean Reef Life), Roatán, Islas de La Bahia, Honduras.

B = *Macrostrombus costatus* (Gmelin, 1791) with 3 eyes. Turtle Crossing, which is a sandy plateau with scattered coral heads from 12-14-meter-deep on the south of the island of Roatán, Bay Islands, opposite of Honduras mainland, Honduras. Photo courtesy of Mickey Charteris (Caribbean Reef Life), Roatán, Islas de La Bahia, Honduras.

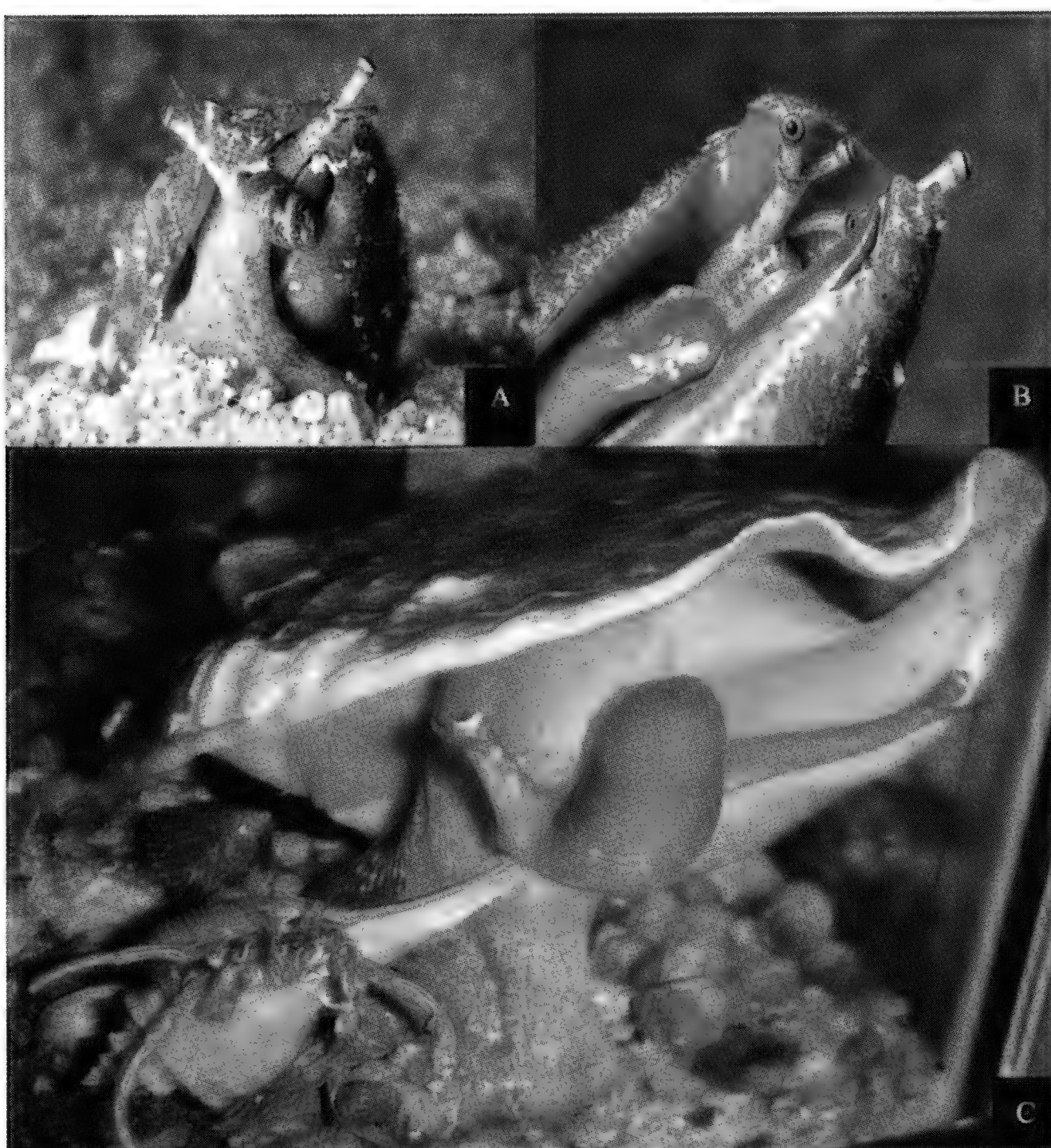


Plate 8. Certain Strombids displaying bifurcated eye stalks

A, B = *Conomurex luhuanus* (Linnaeus, 1758) with 3 eyes, Okinawa, Japan. Photo courtesy of Shawn Miller (Okinawa Nature Photography), Okinawa, Japan.

C = *Macrostrombus costatus* (Gmelin, 1791). Aquarium photo, courtesy of Tammy Myers, Ormond Beach, Florida, USA.

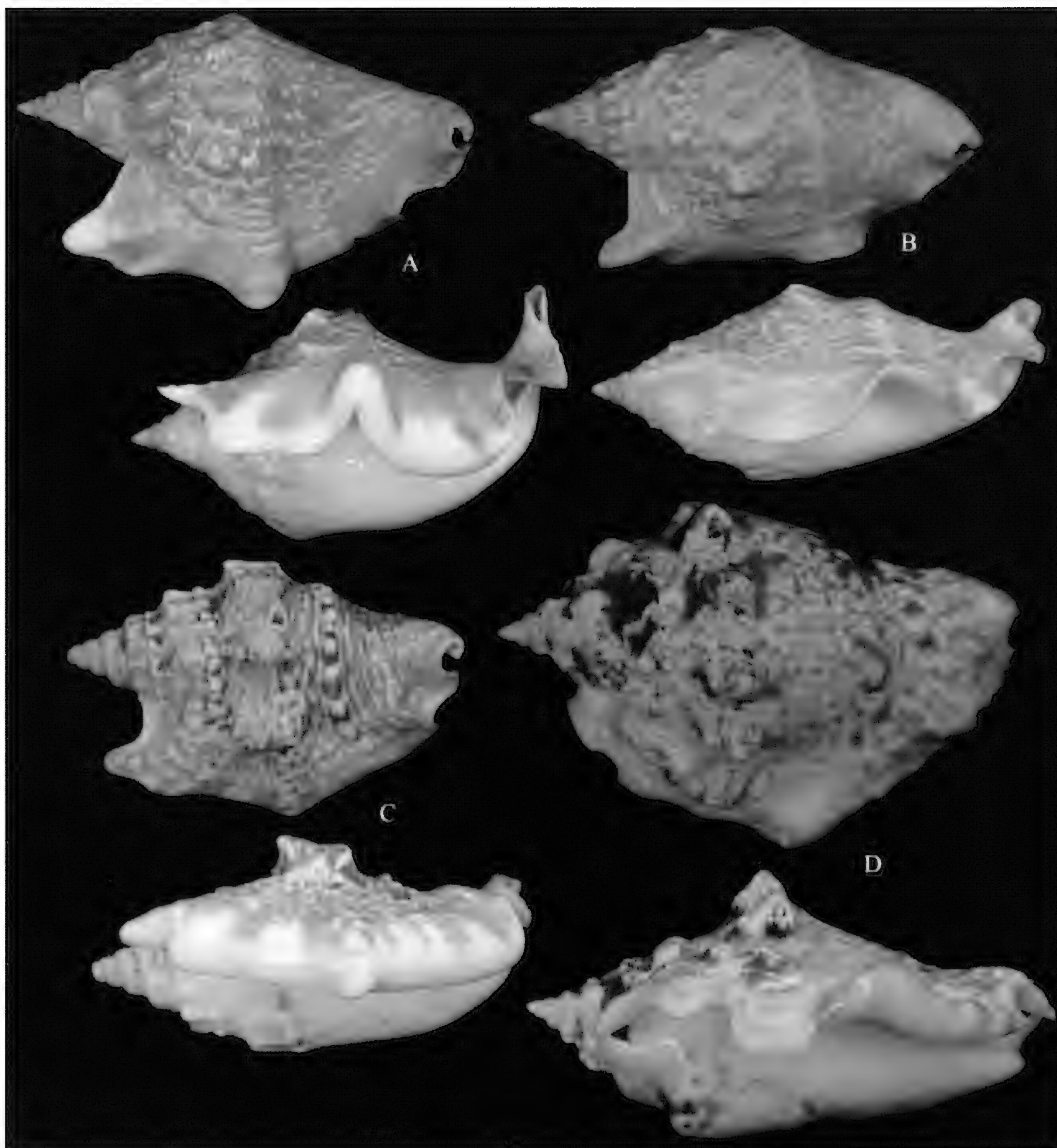


Plate 9. Various Strombid shells displaying growth structures

A = *Euprotomus bulla* (Röding, 1798). Bohol, Philippines. H. 59 mm AMD STR1428. Sharp additional shoulder lacking knobs, ending in the apertural rim with a narrow indentation.

B = *Euprotomus bulla* (Röding, 1798). Beni Island, Philippines. H. 58 mm AMD STR2227. With raised dorsal rim which points at an early tissue damage. But ending in the apertural rim as almost perfect second strombid notch.

C = *Euprotomus aurisdianae* (Linnaeus, 1758). Beni Island, Philippines. H. 51.7 mm AMD STR3079. Looks like a undamaged shell, but with elongated or double shoulder knobs.

D = *Lentigo lentiginosus* (Linnaeus, 1758). Olango Island, Philippines. H 71.5 mm STR2728. Perfect shell, no damage.

A New Species of *Ophioglossolambis* Dekkers, 2012 from the Mascarene Islands (Mollusca: Gastropoda: Strombidae)

David Lum

Honolulu County, Hawaii 96709

davidkwlum@hawaii.rr.com

ABSTRACT This paper describes a new species of *Ophioglossolambis* Dekkers, 2012 from the Mascarene Islands (Mauritius, Rodrigues, and Réunion) and Saint Brandon (also known as Cargados Carajos) Shoals in the western Indian Ocean as *Ophioglossolambis itsumiae*. It is separated from *Ophioglossolambis digitata* (Perry, 1811), its closest congener from the coastal waters of Madagascar and East Africa, by its typically larger and broader build, longer spines, lighter coloration, a more flared labral flange, and, most especially, very compact and short spire.

KEYWORDS Gastropoda, Strombidae, *Ophioglossolambis itsumiae*, *O. digitata*, *O. violacea*, Mascarene Islands, Mauritius, Rodrigues, Réunion, Saint Brandon (Cargados Carajos) Shoals, South Equatorial Current

INTRODUCTION

The Mascarene Islands and the Saint Brandon Shoals (henceforth referred to as the Mascarenes) comprise a highly geographically isolated archipelago located from 680 to 1460 kilometers east of Madagascar in the western Indian Ocean. This isolation has produced a high degree of endemism among marine species (Thébaud *et al.*, 2009) such as the well-known and unique violet spider conch *Ophioglossolambis violacea* (Swainson, 1821) and presents opportunities for the discovery of other endemics there, such as the subject of this paper. This paper will compare differentiating conchological morphometric characteristics and discuss possible environmental influences respective to colonization and evolution.

ABBREVIATIONS AND ACRONYMS

DL – David Lum

BPBM – Bernice Pauahi Bishop Museum

L, W, H – length, width & height

RC – Roger Clark

SR – Spire Ratio

MATERIAL AND METHODS

Eight fully mature specimens of *O. itsumiae* were compared to nine fully mature specimens of *O. digitata* from various populations found in the western Indian Ocean. Additionally, the author compared photographs of specimens of *O. itsumiae* not available for direct study with *O. digitata* to further validate the uniqueness of the new species.

All specimens exhibited in this paper were photographed with a monopod-mounted Nikon digital single-lens reflex camera. Lens focal length was set at 50mm or greater to minimize image distortion. White fluorescent desk lamps were used for lighting. In-camera white balance and Adobe Photoshop Elements 2020 were utilized for minor image adjustments to ensure realistic rendering of color.

Comparative dimensional measurements are enumerated in millimeters (mm). Weight is measured in grams (g).

SYSTEMATICS

Superfamily: Stromboidea Rafinesque, 1815

Epifamily: Neostromboidae Maxwell, Dekkers, Rymer & Congdon, 2019

Family: Strombidae Rafinesque, 1815

Genus: *Ophiglossolambis* Dekkers, 2012

Ophiglossolambis itsumiae Lum, new species
(Figures 1, 2, 4, Plate 1)

Description. Large (152.5 to 187.4 mm), broad, dorsally-compressed shell with a very short, compact spire; eight major dorsally-compressed, digit-like spines that extend to the right from the labrum; siphonal canal long and straight; smaller labral spines in between major spines in some specimens; posterior-most spine bifurcate and touches spire, with the smaller (left) branch forming a spoon-like structure; shoulder cord of the teleoconch (P1) has five prominent, rounded knobs located between left margin and beginning of the labral flange, with the largest knob at the top of the shell; two other closely spaced primary cords (P2-P3) with three to five smaller knobs on the left half of the shell starting from the left side up to the centerline of the dorsum; a series of thin, less distinct spiral cords found across the shell in between the P1 cord and tip of the siphon; rounded, spiny processes along edge of the labrum between the stromboid notch and start of the siphonal canal; spiny processes on the right edge of the siphon that are contiguous with cords spiraling along the siphon in very mature specimens (e.g., Paratype 1, Plate 1); surface of body satiny to slightly glossy with light yellowish-tan background coloration; dorsal pattern indistinct; ventral surface of the body whorl with tan bands or wavy lines; aperture elongated with a thickened columellar plate; columellar plate and aperture lined with strongly-developed white lirae with orange and purple in the interstices

radiating roughly perpendicular to the aperture; the posterior-most lirae of very mature specimens transition into robust, white, cobble-like bumps that superficially resemble human teeth; internal surface of the shell creamy orange; periostracum thin, smooth, and yellowish brown; operculum smooth, brown, and crescent-shaped with smooth edges.

Type Material.

Types: LxWxH (maximum dimensions), weight / location of origin / repository

Holotype. 172.4x84.8x48.1, 132 g /

Mascarenes / coll. BPBM (accession # 2021.010, catalog # 288445)

Paratype 1. 187.4x84.5x51.9, 139 g / La Réunion Island / coll. DL

Paratype 2. 178.2x77.9x47.1, 123 g / Saint Brandon Shoals, Territory of Mauritius / coll. DL

Paratype 3. 160.3x62.7x37.9, 70 g / Mauritius Island / coll. DL

Paratype 4. 170.7x75.8x47.2, 130 g / Mascarenes / coll. DL

Paratype 5. 152.5x69.0x41.0, 90 g / Mascarenes / coll. DL

Paratype 6. 156.0x71.6x41.73 / Saint Brandon Shoals, Territory of Mauritius / coll. RC

Paratype 7. 167.5x81.2x50.7, 135 g / Mascarenes / coll. DL (incomplete siphonal canal due to filing)

Type Locality. The holotype (Figure 1) was collected in the Mascarenes but specific island location for it is not available. The paratypes are from various locations in the Mascarenes.

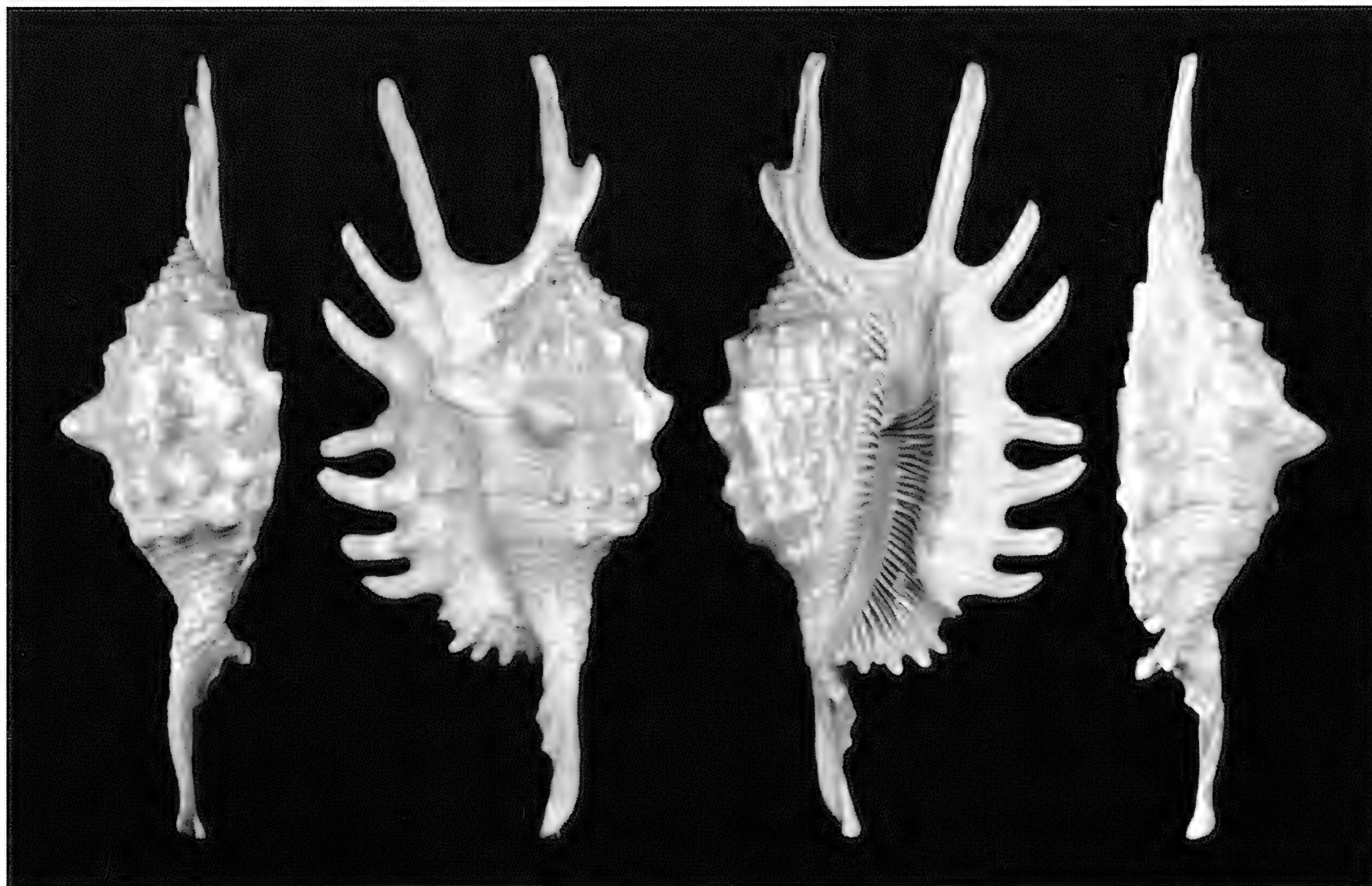


Figure 1. *Ophioglossolambis itsumiae* n. sp., Mascarene Islands, 172.4 mm, holotype. Photos by D. Lum.

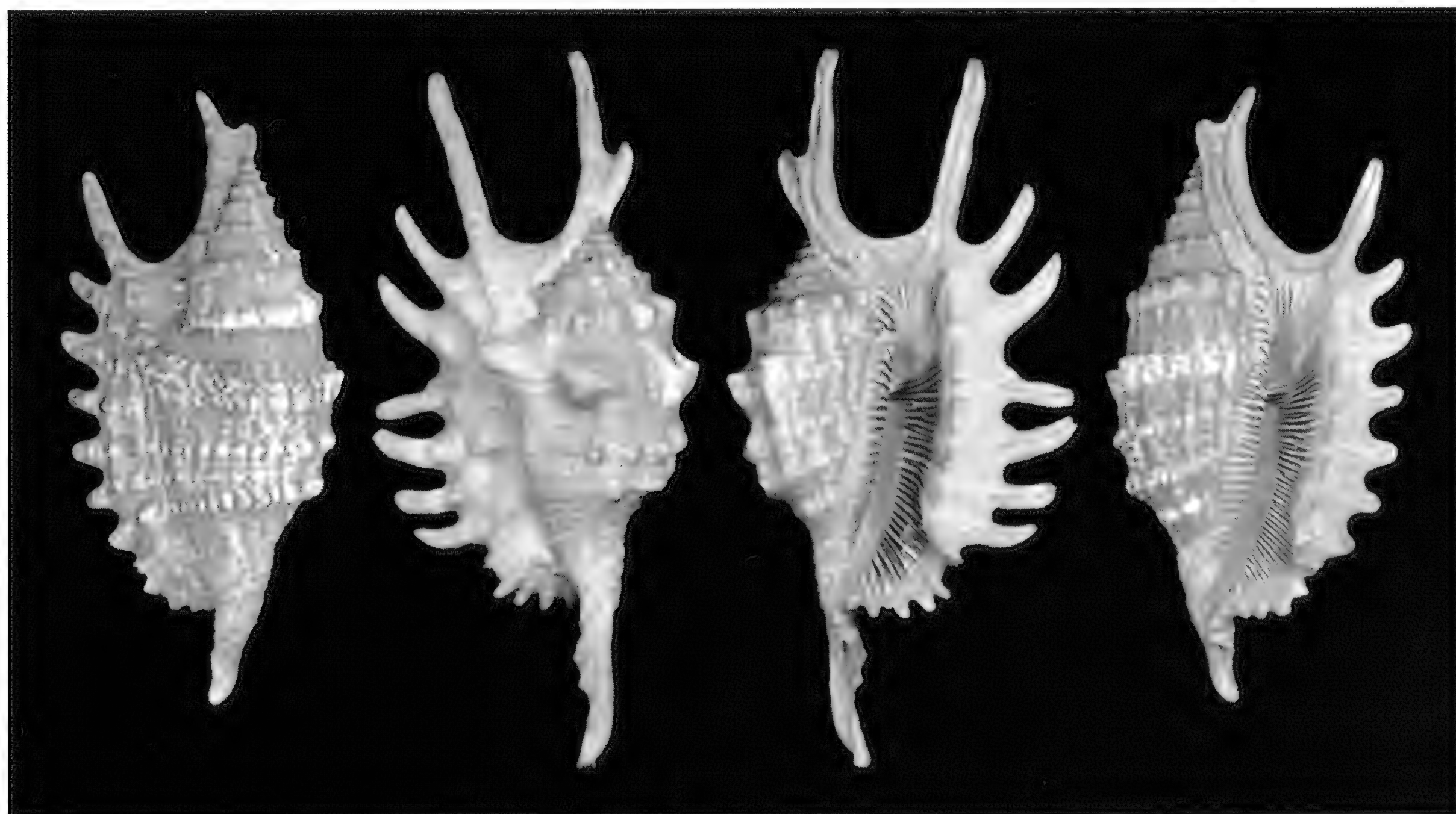


Figure 2. *O. itsumiae* holotype (center) compared with a 149.6 mm specimen of *O. digitata* closely resembling the illustration in Perry's 1811 description of *Strombus digitatus*. To scale, the images show their distinct differences. Photos by D. Lum.

Animal Characteristics. No live animal of *O. itsumiae* was available for study, but it is likely very similar to the animal of *O. digitata*.

Habitat and Distribution. The various Mascarene Islands (Figure 3) were formed at different times over the last 15 million years by oceanic volcanic activity. Deep water exists off their coasts. The Mascarene Plateau is the major undersea feature that connects the archipelago together, but they have never been connected to any other land masses by land bridges or a shallow continental shelf. The dominating current passing through the Mascarenes is the powerful westward flowing South Equatorial Current (SEC) (Pous *et al.*, 2013). Coral reef development is extensive but discontinuous around most of Mauritius, nearly continuous around Rodrigues, and very restricted at Réunion. Saint Brandon Shoals has a well-developed coral-reef arc and sand cays (J. Turner & R. Klaus, 2005).

The collection depth of the type specimens varies from 5 to 55 meters. Mollusks of the family Strombidae are typically shallow water species that are highly dependent on soft-leaved sea grasses and algae for food. As such, it is not likely that *O. itsumiae* is found much deeper than 55 meters due to low light levels beyond this depth limiting the growth of much of its food source. According to Dr. Maurice Jay, a collector from Réunion Island, *O. digitata* is found on dead corals on the outer slope of the barrier reef from 10 to 40 m on rocky bottoms with algae (Réunion Island Mollusks website, 2021).

Etymology. *Ophioglossolambis itsumiae* is named in honor of Itsumi Kanamori Lum, the author's wife, for her grace and infinite patience with her husband's esoteric interests.

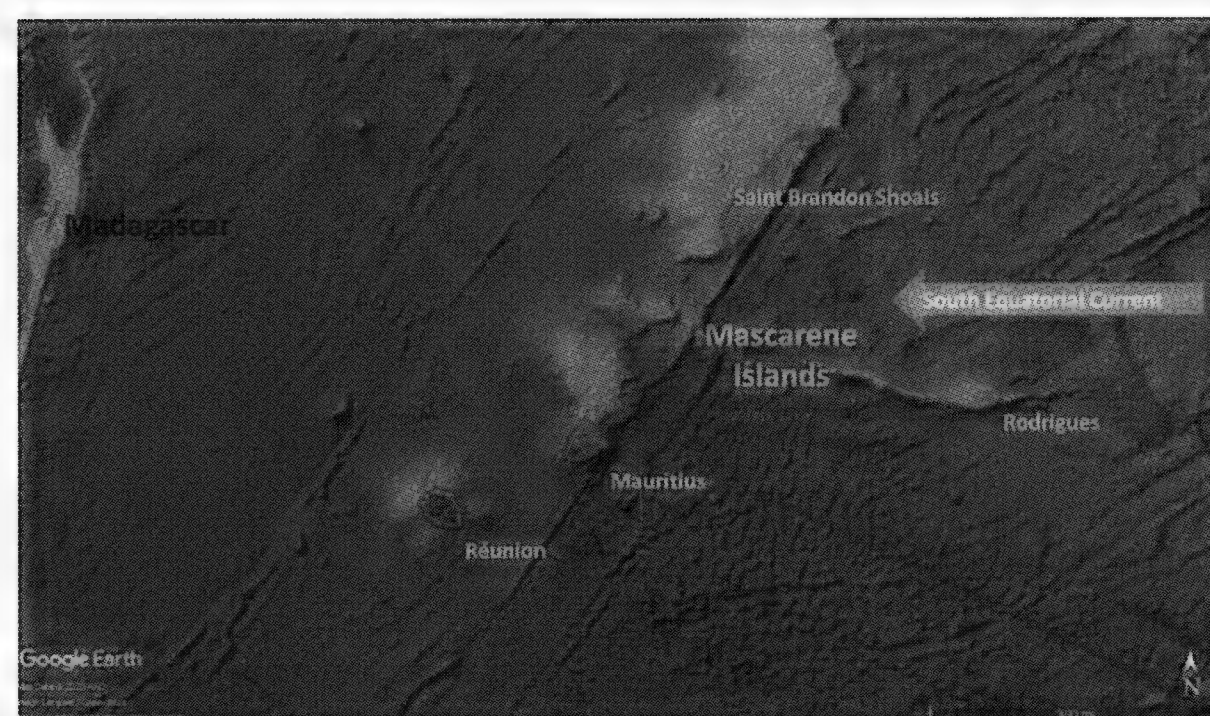


Figure 3. The Mascarene Islands is the type locality of *O. itsumiae*. The westward flow of the powerful South Equatorial Current enhances biological isolation of these islands from the rest of Africa. (Source: Google Earth Pro.)

Comparison. *O. itsumiae* can be readily distinguished from the other two described extant species of the genus *Ophioglossolambis*. The differences to *O. violacea* are stark and will not be underscored in writing here, but several specimens are illustrated in Plate 3 for clarity.

A key diagnostic characteristic to separate *O. itsumiae* from *O. digitata* is the shape of the spire, which can be expressed as a Spire Ratio (SR) defined here as the length of the spire (as measured along the top of the shell) divided by the width of the spire (as measured from the dorsal to basal sides) (Figure 4). The spire of *O. itsumiae* is consistently short and compact, while that of *O. digitata* tends to be significantly more prominent and variable in shape, as can be seen when comparing the standard deviation (Std Dev) of the SRs of the two species. The author chose this ratio because the spires of all examined specimens of both species were intact, while the spines and siphons could be severely damaged and not as supportive of objective comparison, even though clear differences do exist between length/width and length/height ratios. Table 1 summarizes the important differences between *O. itsumiae* and *O. digitata*.

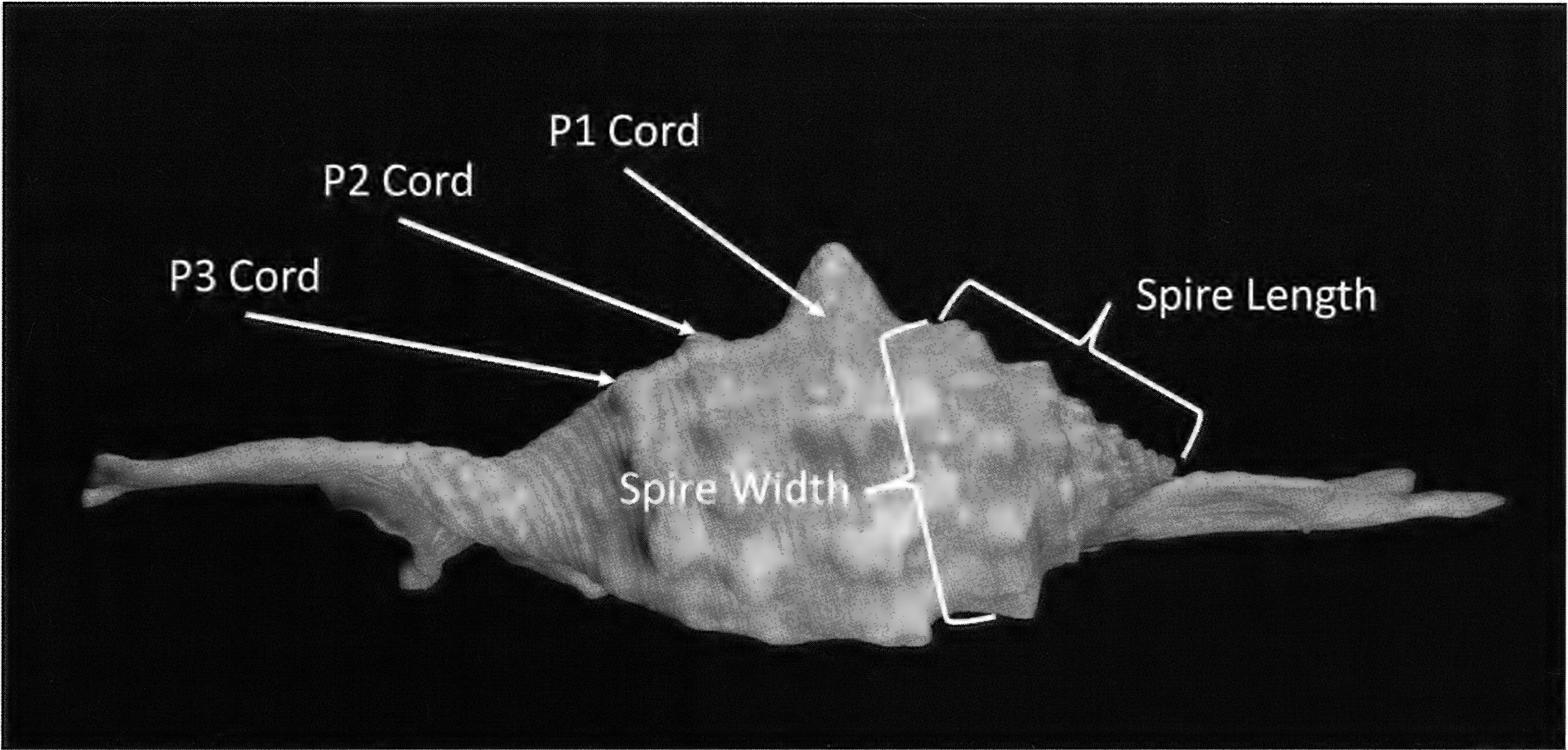


Figure 4. Image of Paratype 7 defining measurement points for spire length and width and locations of primary cords. Cord numbering modeled after the nomenclature for Muricidae (Merle, 2005). Photo by D. Lum.

Characteristic	<i>O. itsumiae</i> (n=8)	<i>O. digitata</i> (n=9)	n = number of specimens
Shell shape	Broad, flattened	Narrower	
Shell length average (range)	168.2 (152.5-187.4) mm*	151.0 (123.2-173.8) mm	
Spire shape	Short and compact	Long, pronounced, and more variable	
Spire Length / Spire Width Ratio	0.97 (Std Dev 0.04)	1.24 (Std Dev 0.20)	
Knobs on primary cords	Strong	Weaker	
Siphon	Long, straight	Short, bending or curling more to right	
Labral spines	Long	Short, particularly along right margin	
Dorsal background color	Yellowish tan	Tan to brown	
Dorsal pattern	Indistinct	Clear wavy lines of varying width	
Distribution	Mascarene Islands	Continental East Africa and Madagascar	
*Average shell length calculation does not include length of paratype 7 (167.7 mm) due to its broken and filed siphon.			

Table 1. Comparison of *O. Itsumiae* to *O. digitata*.

DISCUSSION

O. itsumiae is introduced at the species level consistent with the precedence established with the splitting of other similar spider conch species, in particular *Lambis pilsbryi* Abbott, 1961 from *Lambis crocata* (Link, 1807) and *Lambis montorum* Cossignani & Lorenz, 2020 from *Lambis scorpius* (Linnaeus, 1758). *O. itsumiae* differs from *O. digitata* to a close degree to that of the other sets of taxa.

Prior to this description, only two *Ophioglossolambis* (“snake tongue *Lambis*”) species were recognized, namely *O. digitata* and *O. violacea*. The differences between these two taxa are unmistakable, while those between *O. digitata* and *O. itsumiae* require more explanation. The combining of *O. digitata* with *O. itsumiae* under one name in the past may be due to the comparatively few *O. itsumiae* specimens available for examination. It has taken the author over seven years of concerted effort to acquire the type specimens used in this

study, and these constitute over half of all specimens known to him. This paper should prove useful towards others finding specimens “hiding in plain sight” in their collections, such as the specimen in the collection of Roger Clark.

O. digitata was originally described as *Strombus digitatus* by Perry, 1811, Plate XIII: “No. 1 *Strombus digitatus*. Shell brown, striped with white; the cheek very much expanded, and divided into ten segments, pointed, rounded, and arcuated; the mouth and columella richly striped with white and red veins, running the whole length of the shell; the beak short. A native of the Eastern Ocean.” The associated color engraving in Perry’s plate is reproduced here in Figure 5. While Perry’s description does not specify the locality of the specimen he depicted, its form is consistent with typical *O. digitata* shells from the East African mainland (Somalia, Kenya, Tanzania, South Africa, and various nearby island groups) and Madagascar [Plate 2 shows various *O. digitata* specimens]. Very clearly shown are the shell’s very long spire and relatively short labral spines. Given that this is Perry’s concept for *Strombus digitatus*, it is well within reason, based on the description of *O. itsumiae* and its comparison to *O. digitata* above, that *O. itsumiae* should be accepted as a valid taxon.

In 1842, Reeve described *Pterocera crocea* as a species. Upon examination of the illustration he used to introduce *P. crocea* (also reproduced in Figure 5), which is only accompanied by general text on the genus *Pterocera* not specific to *crocea*, it is quite apparent that it is just a variation of *O. digitata* that resembles the largest *O. digitata* shown in Plate 2. No locality data was provided in this description. Specimens of *O. itsumiae* have occasionally been traded as *Lambis digitata* form *crocea*, making loose usage of Reeve’s moniker, but it

is clear from physical comparison that *O. itsumiae* and *P. crocea* cannot be synonymized.

The geographic isolation of the Mascarenes from the continent of Africa and Madagascar, locations where *O. digitata* is prevalent, supports the evolution of unique marine species around these remote islands. In addition to physical distance, the powerful east to west flow of the South Equatorial Current and associated current/gyre systems result in further oceanographic isolation of these islands (Obura 2012). Clear evidence of this is the existence in the Mascarenean Molluscan Subprovince of such well-known endemic mollusks as *Harpa costata* (Linnaeus, 1758), *Conus julii* Liénard, 1870, *Cribrarula esontropia* (Duclos, 1833), *Bistolida owenii* (Sowerby I, 1837), and *Cribrarula cribellum* (Gaskoin, 1849) (see Petuch & Berschauer, 2020, at pp. 226-227). The existence of *O. digitata*’s congener *O. violacea* as an endemic to the Mascarenes gives particularly strong support to the idea that another endemic strombid, namely *O. itsumiae*, could have evolved in the Mascarenes.

It is not yet known whether *O. digitata* is the progenitor of *O. itsumiae* or vice versa, but it is reasonable to hypothesize that the former is more likely the case, since *O. digitata* is much more widespread and may even today occasionally reach the Mascarenes based on an image of a typical *O. digitata* in Dekkers, 2012 labeled as originating from Mauritius. Exceptionally hardy veligers of *O. digitata* may have made a very circuitous route via ocean eddies and the meandering of today’s major Indian Ocean currents (Perpetual Ocean website) to arrive at the Mascarenes sometime in the past to give eventual rise to both *O. violacea* and *O. itsumiae*. That *O. violacea* and *O. itsumiae* do not have well-established populations west of the Mascarenes may speak to the existence of harsher oceanic conditions today than when

Ophioglossolambis first reached the Mascarenes. Evidence that more benign, warmer conditions likely existed for the migration of *Lambis*-like species in the past is the late Pleistocene fossil record of Hawaiian Islands, another very isolated archipelago, which contains an extinct form of *Harpago chiragra* (Linnaeus, 1758) found above today's sea level (D. R. Muhs *et al.*, 2002).

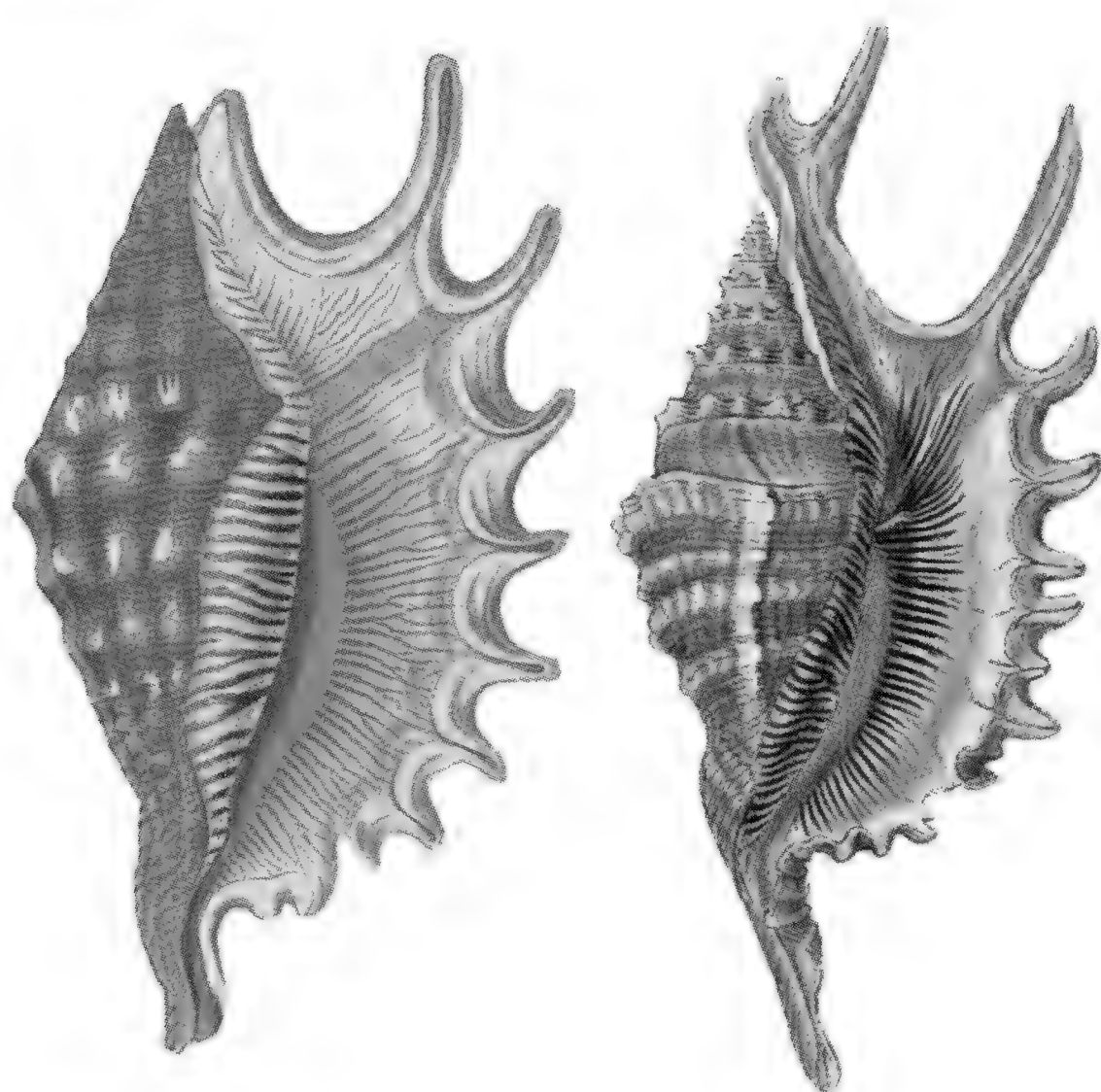


Figure 5. Original illustrations of *Strombus digitatus* Perry, 1811 (left) and *Pterocera crocea* Reeve, 1842 (right).

ACKNOWLEDGEMENTS

I greatly thank the San Diego Shell Club, and David Berschauer in particular, for accepting and publishing this paper in "The Festivus". My appreciation also goes to the anonymous reviewers, and to Roger Clark for his further review of the manuscript and bringing Paratype 5 of *O. itsumiae* to my attention.

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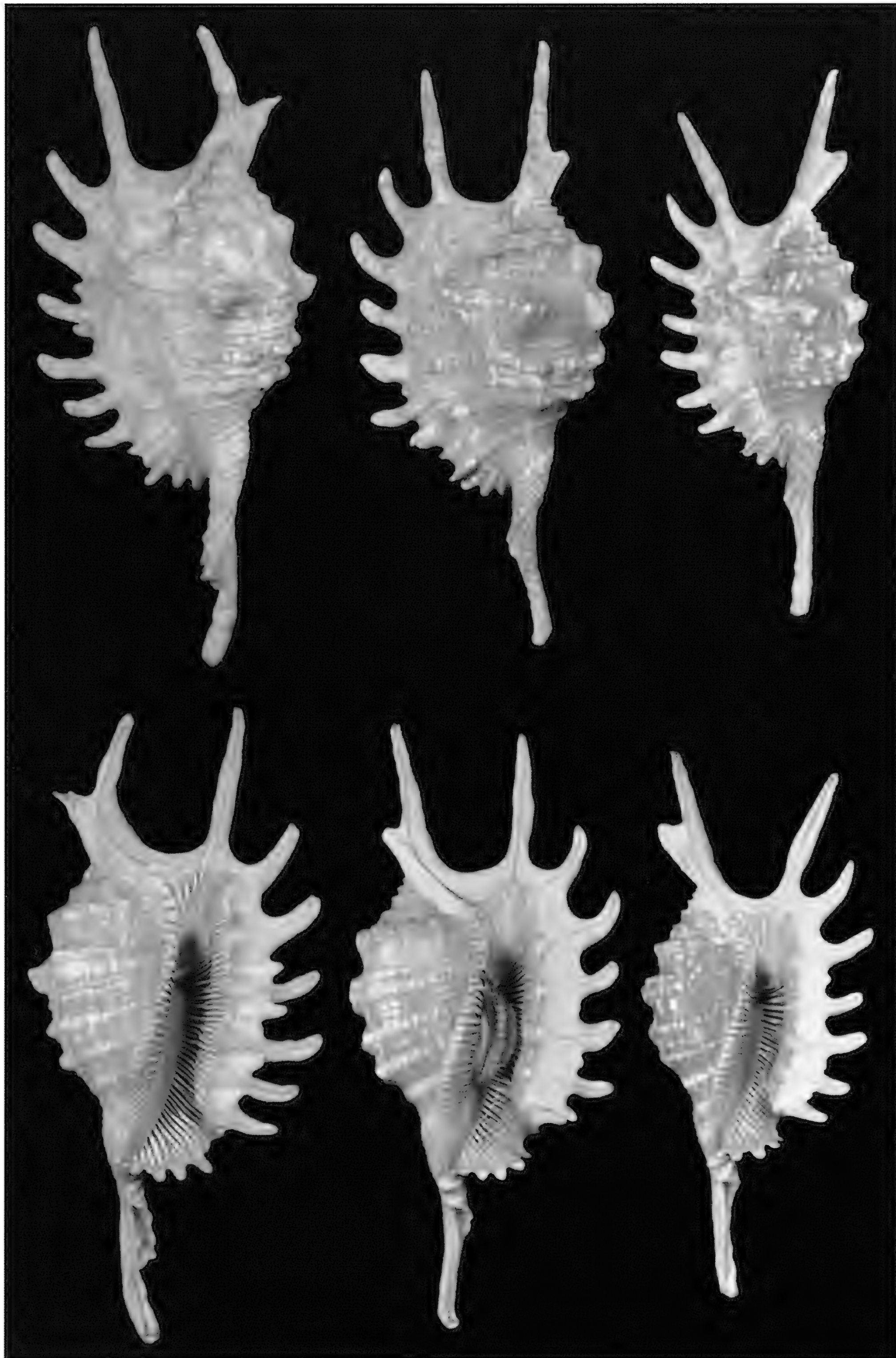


Plate 1. *Ophioglossolambis itsumiae* n. sp. Left to right: Paratype 1 (La Réunion Island 187.4 mm), Paratype 2 (Saint Brandon Shoals 178.2 mm), and Paratype 3 (Mauritius Island 160.3 mm). To scale. Photos by D. Lum.

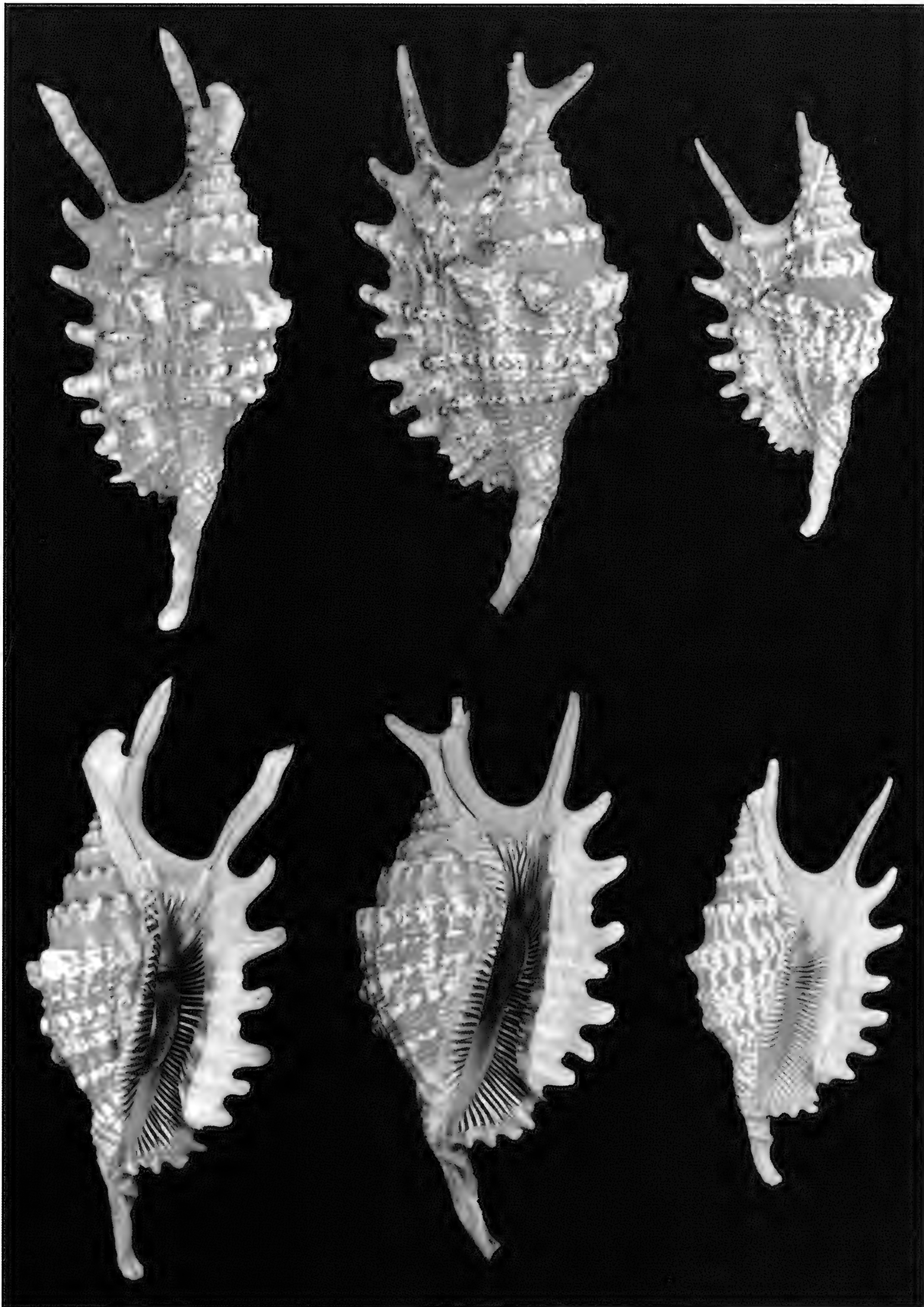


Plate 2. *Ophioglossolambis digitata* from Madagascar (left to right 173.8 mm, 162.6 mm and 123.2 mm) showing variability in spire development (typical in larger shells and particularly long and steep in smallest shell. The largest shell closely resembles the specimen of *Pteroceras crocea* illustrated in Reeve, 1842. To scale. Photos by D. Lum.

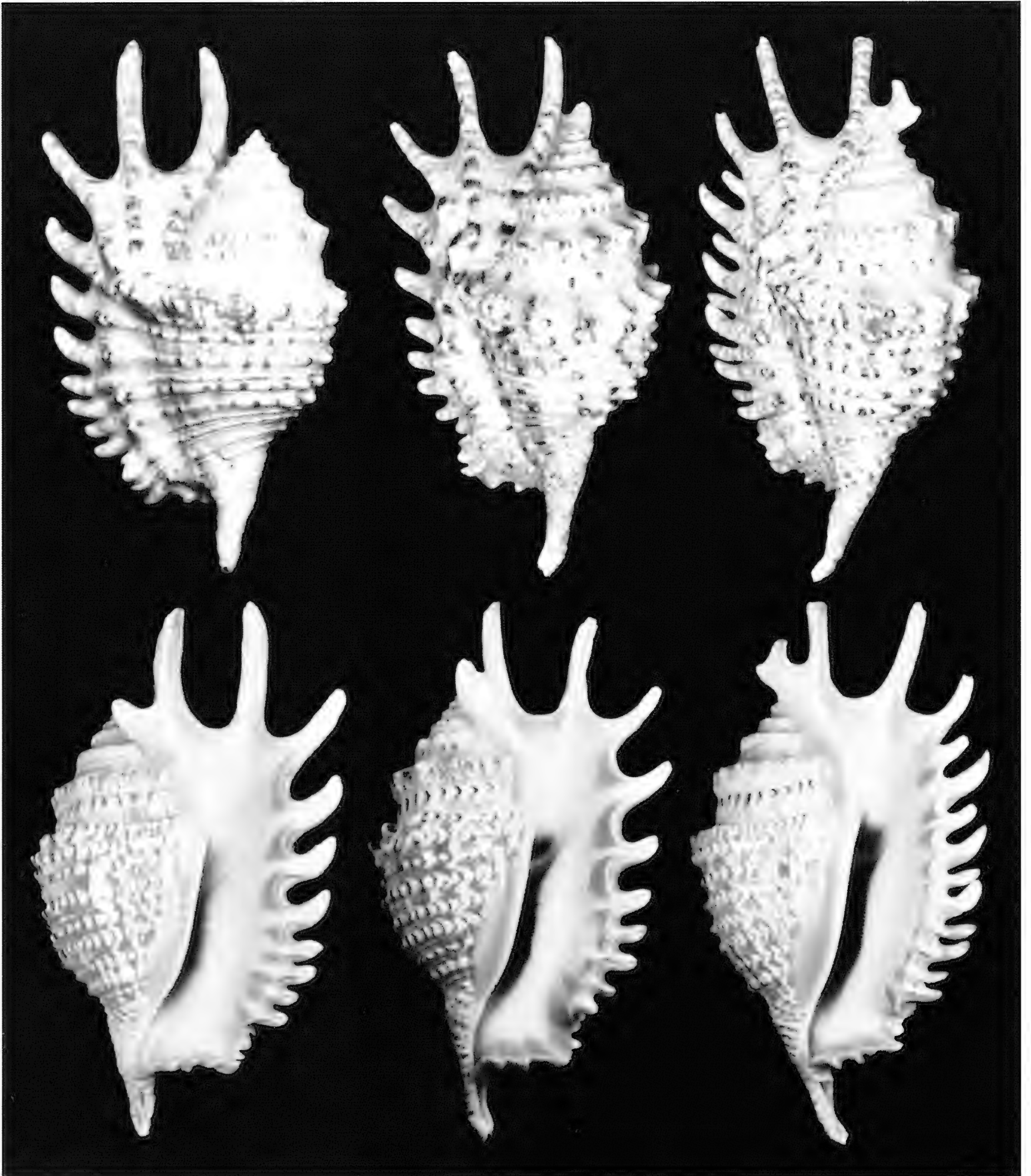


Plate 3. *Ophioglossolambis violacea* from the Mascarene Islands (left to right: Mauritius 122.6 mm, Saint Brandon Shoals 124.8 mm, and Saint Brandon Shoals 125.0 mm) showing variability. Note the ribs on the columellar shield of the specimen from Mauritius (collected over 40 years ago) that the recent Saint Brandon Shoals specimens lack. The left and middle specimens display typical spine formation, while the right specimen has an abnormally high number of digits. To scale. Photos by D. Lum.

Registration of Neostromboidae Clades in the RegNum of the PhyloCode, and Errata

Stephen J. Maxwell

College of Science and Engineering, James Cook University, P.O. Box 6811, Cairns, Queensland 4870, Australia. stephen.maxwell@my.jcu.edu.au

ABSTRACT This paper provides the International Code of Phylogenetic Nomenclature RegNum repository registration numbers for the clades defined in *The Festivus*. The definitions are based on the current understanding of the internal resolution within Stromboidae, and maybe amended as further taxa are resolved. This set of registration references reflects the refined definitions that have become necessary with the activation of the PhyloCode (2020) and the RegNum protocols. The use of types is not a requirement of the PhyloCode, but there use herein does resolve much of the differences between the ICZN and PhyloCode in practice. Errata for Maxwell and Rymer (2021) are noted at the end.

KEY WORDS ICZN, PhyloCode, RegNum, Taxonomy, Neostrombidae

INTRODUCTION

The PhyloCode (2020) saw some major shifts in terminology in relation to definitional structure particularly with node-based clades being now *minimum-clades* and stem-based clades now *maximum-clades*, and the need to explicitly state the type of clade in definitions. The revised PhyloCode (2020) has more formalistic regulation of definitional requirements; however, historical clades that were defined prior to the new code form should be viewed as potentially valid (PhyloCode 6.2.1), based on whether there is a clear intent within the definition, all clades in Maxwell *et al.* (2019), Liverani *et al.* (2021) and Maxwell and Rymer (2021) fulfil this requirement. However, these now must be modified and registered as *nomen cladi conversum*. The list below contains these converted clades with their RegNum registration numbers. The RegNum is the formal international clade name repository for the PhyloCode. Furthermore, the use of types is

not a requirement of the PhyloCode but are herein included to bring resolution of the taxonomy between the codes in structural requirement. As time progresses, I envisage that the PhyloCode will dominate the ordering of taxa above the ICZN rank of genera, and that the ICZN will have a role in the ordering of species terminal.

RegNum REGISTRATION

Neostromboidae Maxwell, Dekkers, Rymer, & Congdon, 2019

[S. Maxwell, this paper]
nomen cladi conversum

Registration Number. 565

Definition. The total clade of the largest crown clade containing *Strombus pugilis* Linné, 1758, *Terebellum terebellum* (Linné, 1758) and *Tibia fusus* (Linné, 1758) but not *Struthiolaria papulosa* (Martyn, 1784) or *Aporrhais pespelecani* (Linnaeus, 1758).

Reference Phylogeny. Figure 2A in Maxwell *et al.* (2019).

Composition. The clade contains members of three families, Strombidae (see Maxwell & Rymer (2021) for content), *Rostellariidae*, and *Seraphsidae*. It excludes *Struthiolariidae* and *Aporrhaidae*,

Diagnostic Apomorphies. The animal possesses eyes on the end of the peduncles. The cephalic tentacle is also located on the peduncle towards the distal end. The radula has a central rachidian tooth with three lateral teeth either side. The foot is laterally compressed, with a defined propodium and a metapodium. The shell form changes upon maturation with the development of an outer lip structure (Maxwell *et al.* 2019, p. 3).

Type Genus. *Strombus* Linné, 1758.

Strombidae Rafinesque, 1815
[S. Maxwell, this paper]
nomen cladi conversum

Registration Number. 566

Definition. The maximum clade consisting of *Aliger gallus* (Linné, 1758) and *Canarium urceus* (Linné, 1758) and all species that share a more recent common ancestor with them than with *Terebellum terebellum* (Linné, 1758) or *Tibia fusus* (Linné, 1758).

Reference Phylogeny. Figure 1 in Maxwell & Rymer (2021).

Composition. The clade containing the two subfamilies *Neostrombinae* (see Maxwell & Rymer (2021) for content) and *Neoaligerinae* (see Maxwell & Rymer (2021) for content). It excludes the *Rostellariidae* and *Seraphsidae*.

Diagnostic Apomorphies. Shell with a body whorl that is longer than the combined teleoconch, stromboidal notch well formed, and body whorls sculpture may vary significantly from that of the teleoconch (Maxwell & Rymer, 2021, p. 46).

Type Genus. *Strombus* Linné, 1758.

Neostrombinae Maxwell & Rymer, 2021

[S. Maxwell, this paper]

nomen cladi conversum

Registration Number. 567

Definition. The maximum clade consisting of *Dolomena pulchellus* (Reeve, 1851) *Conomurex luhuanus* (Linné, 1758), *Laevistrombus canarium* (Linné, 1758), and *Neostrombus fusiformis* (Sowerby II, 1842) and all species that share a more recent common ancestor with them than with *Aliger gallus* (Linné, 1758), *Euprotomus aurisdiane* (Linné, 1758), *Lambis lambis* (Linné, 1758), *Gibberulus gibberulus* (Linné, 1758) or *Persististrombus granulatus* (Swainson, 1822).

Reference Phylogeny. Figure 3 in Maxwell & Rymer (2021).

Composition. The clade containing the two tribes *Neostrombini* (see Liverani *et al.* (2021) for content) and *Dolomini* (see Dekkers & Maxwell (2020) for content), and also other genera such as *Conomurex* (see Abbott (1960) for content) and *Laevistrombus* (see Maxwell *et al.* (2019a) for content). It excludes *Neoaligerinae* (see Maxwell *et al.* (2020) for content).

Diagnostic Apomorphies. There is a basal peg on the radula first lateral tooth. The shells are small to medium in size. The posterior canal is straight and extended. Dorsum of the body whorl often smooth or with limited shoulder ornamentation. (Maxwell & Rymer, 2021, p. 47).

Type Genus. *Canarium* Schumacher, 1817.

Neostrombini Liverani, Dekkers & Maxwell, 2021

[S. Maxwell, this paper]

nomen cladi conversum

Registration Number. 559

Definition. The maximum clade consisting of *Canarium urceus* (Linné, 1758),

Maculastrombus maculatus (Sowerby II, 1842), *Neostrombus fusiformis* (Sowerby II, 1842), *Terestrombus fragilis* (Röding, 1798) and *Tridentarius denatus* (Linné, 1758) and all species that share a more recent common ancestor with them than with *Dolomena pulchellus* (Reeve, 1851), *Conomurex luhuanus* (Linné, 1758) or *Laevistrombus canarium* (Linné, 1758).

Reference Phylogeny. Figure 3 in Maxwell & Rymer (2021).

Composition. An internal clade within *Neostrombinae* containing the five genera *Maculastrombus* (see Liverani *et al.* (2021) for content), *Neostrombus* (see Liverani *et al.* (2021) for content), *Terestrombus* (see Liverani *et al.* (2021) for content), *Tridentarius* (see Liverani *et al.* (2021) for content) and *Canarium* (see Liverani *et al.* (2021) for content). It excludes *Dolomina* (see Dekkers & Maxwell (2020) for internal content) and other unresolved clades such as *Conomurex* (see Abbott (1960) for content), *Laevistrombus* (see Maxwell *et al.* (2019a) for content) and *Barneystrombus*.

Diagnostic Apomorphies. Shells small with a narrow aperture that is posteriorly constricted forming a narrow sinus with the body whorl. The radula has a central tooth with five cusps the central being the largest, and lateral teeth with a basal peg (Liverani *et al.* 2021, p. 28).

Type Genus. *Neostrombus* Liverani, Dekkers & Maxwell, 2021.

Canarium Schumacher 2002

[S. Maxwell, this paper]

nomen cladi conversum

Registration Number. 569

Definition. The maximum clade consisting of *Canarium urceus* (Linné, 1758) and all species that share a more recent common ancestor with them than with *Tridentarius dentatus* (Linné, 1758), *Terestrombus fragilis* (Röding, 1798), *Maculastrombus maculatus* (Sowerby II, 1842) or *Neostrombus fusiformis* (Sowerby II, 1842).

Reference Phylogeny. Figure 1 in Liverani *et al.* (2021).

Composition. This clade belongs to the *Neostrombini* (see Liverani *et al.* (2021) for content) and contains *Canarium* (see Liverani *et al.* (2021) for content). It does not include members of the *Maculastrombus* (see Liverani *et al.* (2021) for content), *Neostrombus* (see Liverani *et al.* (2021) for content), *Terestrombus* (see Liverani *et al.* (2021) for content) and *Tridentarius* (see Liverani *et al.* (2021) for content).

Diagnostic Apomorphies. Small solid shells with an elliptic-rhomboid form and a variable height of teleoconch, and a cross section of the labrum that is thickened with a fine ridge (Liverani *et al.* 2021 p. 29)

Type Species. *Canarium urceus* (Linné, 1758)

Maculastrombus Liverani, Dekkers & Maxwell, 2021

[S. Maxwell, this paper]

nomen cladi conversum

Registration Number. 561

Definition. The maximum clade consisting of *Maculastrombus maculatus* (Sowerby II, 1842) and *Maculastrombus depauperatus* (Dautzenberg & Bouge, 1933), and all species that share a more recent common ancestor with them than with *Canarium urceus* (Linné, 1758), *Terestrombus fragilis* (Röding, 1798), *Tridentarius dentatus* (Linné, 1758) or *Neostrombus fusiformis* (Sowerby II, 1842).

Reference Phylogeny. Figure 1 in Liverani *et al.* (2021).

Composition. This clade belongs to the *Neostrombini* (see Liverani *et al.* (2021) for content) and contains *Maculastrombus* (see Liverani *et al.* (2021) for content). It does not include members of the *Neostrombus* (see Liverani *et al.* (2021) for content), *Terestrombus* (see Liverani *et al.* (2021) for content), *Tridentarius* (see Liverani *et al.* (2021)

for content) and *Canarium* (see Liverani *et al.* (2021) for content).

Diagnostic Apomorphies. Shells with a cuneate outer lip and smooth body whorl, the later teleoconch with distinctive tubercles (Liverani *et al.* 2021, p. 33).

Type Species. *Maculastrombus maculatus* (Sowerby II, 1842).

Neostrombus Liverani, Dekkers & Maxwell,
2021

[S. Maxwell, this paper]
nomen cladi conversum

Registration Number. 562

Definition. The maximum clade consisting of *Neostrombus fusiformis* (Sowerby II, 1842) and all species that share a more recent common ancestor with them than with *Canarium urceus* (Linné, 1758), *Terestrombus fragilis* (Röding, 1798), *Tridentatarius dentatus* (Linné, 1758) or *Maculastrombus maculatus* (Sowerby II, 1842).

Reference Phylogeny. Figure 1 in Liverani *et al.* (2021).

Composition. This clade belongs to the *Neostrombini* (see Liverani *et al.* (2021) for content) and contains *Neostrombus* (see Liverani *et al.* (2021) for content). It does not include members of the *Maculastrombus* (see Liverani *et al.* (2021) for content), *Terestrombus* (see Liverani *et al.* (2021) for content), *Tridentatarius* (see Liverani *et al.* (2021) for content) or *Canarium* (see Liverani *et al.* (2021) for content).

Diagnostic Apomorphies. The shell is fusiform with a columella that is diminished posteriorly, with a cuneate cross section of the labrum and lacking a fine ridge at the edge. (Liverani *et al.* 2021, p. 34).

Type Species. *Neostrombus fusiformis* (Sowerby II, 1842).

Terestrombus Kronenberg & Vermeij 2002

[S. Maxwell, this paper]
nomen cladi conversum

Registration Number. 563

Definition. The maximum clade consisting of *Terestrombus fragilis* (Röding, 1798) and all species that share a more recent common ancestor with them than with *Canarium urceus* (Linné, 1758), *Tridentatarius dentatus* (Linné, 1758), *Maculastrombus maculatus* (Sowerby II, 1842) or *Neostrombus fusiformis* (Sowerby II, 1842).

Reference Phylogeny. Figure 1 in Liverani *et al.* (2021).

Composition. This clade belongs to the *Neostrombini* (see Liverani *et al.* (2021) for content) and contains *Terestrombus* (see Liverani *et al.* (2021) for internal content). It does not include members of the *Maculastrombus* (see Liverani *et al.* (2021) for content), *Neostrombus* (see Liverani *et al.* (2021) for content), *Tridentatarius* (see Liverani *et al.* (2021) for content) and *Canarium* (see Liverani *et al.* (2021) for internal content).

Diagnostic Apomorphies. Shell small, thin-shelled, spirally and axially almost smooth strombids with rounded, basally unconstricted whorls, thin, determinate, unglazed outerlip, indistinct stromboid notch, and thin columellar callus (Kronenberg and Vermeij 2002, p. 49).

Type Species. *Terestrombus fragilis* (Röding, 1798).

Tridentatarius Kronenberg & Vermeij 2002

[S. Maxwell, this paper]
nomen cladi conversum

Registration Number. 564

Definition. The maximum clade consisting of *Tridentatarius dentatus* (Linné, 1758) and all species that share a more recent common ancestor with them than with *Canarium urceus* (Linné, 1758), *Terestrombus fragilis*

(Röding, 1798), *Maculastrombus maculatus* (Sowerby II, 1842) or *Neostrombus fusiformis* (Sowerby II, 1842).

Reference Phylogeny. Figure 1 in Liverani *et al.* (2021).

Composition. This clade belongs to the *Neostrombini* (see Liverani *et al.* (2021) for content) and contains *Tridentarius* (see Liverani *et al.* (2021) for internal content). It does not include members of the *Maculastrombus* (see Liverani *et al.* (2021) for content), *Neostrombus* (see Liverani *et al.* (2021) for content), *Terestrombus* (see Liverani *et al.* (2021) for content) and *Canarium* (see Liverani *et al.* (2021) for internal content).

Diagnostic Apomorphies. Small, high-spired strombids with strongly reduced spiral sculpture, determinate outerlip with glazed adult edge and three sharp basal projections. An indistinct stromboid notch separates the two abapical most projections. A thick, narrow columellar callus is present, and along adapical apertural channel (Kronenberg and Vermeij 2002, p. 51).

Type Species. *Tridentarius dentatus* (Linné, 1758).

Dolomenini Dekkers & Maxwell, 2020

[S. Maxwell, this paper]

nomen cladi conversum

Registration Number. 580

Definition. The maximum clade consisting of *Doxander vittatus* (Linné, 1758), *Neodilatilabrum marginatum* (Linné, 1758), *Ministrombus minimus* (Linné, 1771), and *Dolomena pulchella* (Reeve, 1851) and all species that share a more recent common ancestor with them than with *Mirabilistrombus listeri* (Gray, 1852), *Neostrombus fusiformis* (Sowerby II, 1842) or *Laevistrombus vanikorensis* (Quoy & Gaimard, 1834).

Reference Phylogeny. Figure 2 in Dekkers & Maxwell (2020).

Composition. This clade is contained within the *Neostrombinae* (see Maxwell & Rymer (2021) for content), contains the two clades *Doxanderina* (see Dekkers & Maxwell (2020) for content) and *Dolomenina* (see Dekkers & Maxwell (2020) for content). It excludes *Conomurex* (see Abbott (1960), for content), *Mirabilistrombus*, *Laevistrombus* (see Maxwell *et al.* (2019a) for content) and *Neostrombini* (see Liverani *et al.* (2021) for content).

Diagnostic Apomorphies. Shells with an early to mid-teleoconch with even axial ornamentation. Outer lip without ornamentation, anterior canal short, shoulder of body whorls with knobs that may be greatly reduced (Dekkers & Maxwell, 2020, p. 41).

Type Genus. *Dolomena* Wenz, 1940.

Doxanderina Dekkers & Maxwell, 2020

[S. Maxwell, this paper]

nomen cladi conversum

Registration Number. 581

Definition. The maximum clade consisting of *Doxander vittatus* (Linné, 1758), *Neodilatilabrum marginatum* (Linné, 1758) and all species that share a more recent common ancestor with them than with *Dolomena pulchella* (Reeve, 1851), *Labiostrombus epidromis* (Linné, 1758), *Ministrombus minimus* (Linné, 1771), *Amabiliplicatus plicatus* (Röding, 1798), *Dominus labiosus* (Wood, 1828), *Pacificus dilatatus* (Swainson, 1821), *Mirabilistrombus listeri* (Gray, 1852), *Neostrombus fusiformis* (Sowerby II, 1842) or *Laevistrombus vanikorensis* (Quoy & Gaimard, 1834).

Reference Phylogeny. Figure 2 in Dekkers & Maxwell (2020).

Composition. This clade is contained within the *Neostrombinae* (see Maxwell & Rymer (2021) for content), contains the two clades *Doxander* (see Dekkers & Maxwell (2020) for content) and *Neodilatilabrum* (see Dekkers & Maxwell

(2020) for content). It excludes *Conomurex* (see Abbott (1960), for content), *Laevistrombus* (see Maxwell *et al.* (2019a) for content), *Dolomenina* (see Dekkers & Maxwell (2020) for content) and *Neostrombini* (see Liverani *et al.* (2021) for content).

Diagnostic Apomorphies. The aperture of the shell is uniformly lirate. There is no marginal fold present on the edge of the outer lip. The outer lip lacks sharpness. The body of the shell is rounded, with a convex flange that may be stepped. There is no flange fold. The spire is sculptured with uniform axial ribs. The columella is straight and mostly smooth. The posterior sinus has uneven sides with the outer side being sharp-edged (Dekkers & Maxwell, 2020, p. 42).

Type Genus. *Doxander* Wenz, 1940.

Doxander Wenz, 1940
[S. Maxwell, this paper]
nomen cladi conversum

Registration Number. 582

Definition. The maximum clade consisting of *Doxander vittatus* (Linné, 1758) and all species that share a more recent common ancestor with them than with *Neodilatilabrum marginatum* (Linné, 1758), *Dolomena pulchella* (Reeve, 1851), *Labiostrombus epidromis* (Linné, 1758), *Ministrombus minimus* (Linné, 1771), *Mirabilistrombus listeri* (Gray, 1852), *Neostrombus fusiformis* (Sowerby II, 1842) or *Laevistrombus vanikorensis* (Quoy & Gaimard, 1834).

Reference Phylogeny. Figure 2 in Dekkers & Maxwell (2020).

Composition. This clade is contained within the *Dolomenini* (see Dekkers & Maxwell (2020) for content) and contains the *Doxander* (see Dekkers & Maxwell (2020) for content). It excludes *Dolomenina* (see Dekkers & Maxwell (2020) for content), *Neodilatilabrum* (see Dekkers & Maxwell (2020) for content).

Conomurex (see Abbott (1960), for content), *Laevistrombus* (see Maxwell *et al.* (2019a) for content), and *Neostrombini* (see Liverani *et al.* (2021) for content).

Diagnostic Apomorphies. Shells with a high spire. The body whorl is smooth or with strong axial folds or spiral lines. The dorsum is often with a central knob on the shoulder. The subsutural cord is well defined. The inside labrum has weak or stronger lirae. Stromboidal notch moderately well formed. The flange is stepped (Dekkers & Maxwell, 2020, p. 42).

Type Species. *Doxander vittatus* (Linné, 1758).

Neodilatilabrum Dekkers, 2008
[S. Maxwell, this paper]
nomen cladi conversum

Registration Number. 583

Definition. The maximum clade consisting of *Neodilatilabrum marginatum* (Linné, 1758) and all species that share a more recent common ancestor with them than with *Doxander vittatus* (Linné, 1758), *Dolomena pulchella* (Reeve, 1851), *Labiostrombus epidromis* (Linné, 1758), *Ministrombus minimus* (Linné, 1771), *Mirabilistrombus listeri* (Gray, 1852), *Neostrombus fusiformis* (Sowerby II, 1842) or *Laevistrombus vanikorensis* (Quoy & Gaimard, 1834).

Reference Phylogeny. Figure 2 in Dekkers & Maxwell (2020).

Composition. This clade is contained within the *Dolomenini* (see Dekkers & Maxwell (2020) for content) and contains the *Neodilatilabrum* (see Dekkers & Maxwell (2020) for content). It excludes *Doxander* (see Dekkers & Maxwell (2020) for content), *Dolomenina* (see Dekkers & Maxwell (2020) for content), *Conomurex* (see Abbott (1960), for content), *Laevistrombus* (see Maxwell *et al.* (2019a) for content), and *Neostrombini* (see Liverani *et al.* (2021) for content).

Diagnostic Apomorphies. Stromboidal notch sinuous. The flange is not stepped. Spire with distinct shoulder with knobs. Body whorl shiny and almost without any sculpture; expanded outer lip thickened at the inner edge and smooth. Aperture smooth within. Columellar smooth, with callous, well-marked. The anterior canal is short. The stromboid notch is moderately developed. The posterior canal is present (Dekkers & Maxwell, 2020, p. 44).

Type Species. *Neodilatilabrum marginatum* (Linné, 1758).

Dolomenina Dekkers & Maxwell, 2020

[S. Maxwell, this paper]

nomen cladi conversum

Registration Number. 584

Definition. The maximum clade consisting of *Dolomena pulchella* (Reeve, 1851), *Labiostrombus epidromis* (Linné, 1758), *Ministrombus minimus* (Linné, 1771), *Amabiliplicatus plicatus* (Röding, 1798), *Dominus labiosus* (Wood, 1828) and *Pacificus dilatatus* (Swainson, 1821) and all species that share a more recent common ancestor with them than with *Doxander vittatus* (Linné, 1758), *Neodilatilabrum marginatum* (Linné, 1758), *Mirabilistrombus listeri* (Gray, 1852), *Neostrombus fusiformis* (Sowerby II, 1842) or *Laevistrombus vanikorensis* (Quoy & Gaimard, 1834).

Reference Phylogeny. Figure 2 in Dekkers & Maxwell (2020).

Composition. This clade is contained within the *Neostrombinae* (see Maxwell & Rymer (2021) for content), contains the six clades: *Dolomena* (see Dekkers & Maxwell (2020) for content), *Ministrombus* (see Dekkers & Maxwell (2020) for content), *Labiostrombus* (see Dekkers & Maxwell (2020) for content), *Amabiliplicatus* (see Dekkers & Maxwell (2020) for content), *Dominus* (see Dekkers & Maxwell (2020) for content) and *Pacificus* (see Dekkers & Maxwell

(2020) for content). It excludes *Doxanderini* (see Dekkers & Maxwell (2020) for content), *Conomurex* (see Abbott (1960), for content), *Laevistrombus* (see Maxwell *et al.* (2019a) for content), and *Neostrombini* (see Liverani *et al.* (2021) for content).

Diagnostic Apomorphies. Shell with uniform spiral sculpture of fine axial ribs. The flange is convex, and a flange fold runs from the posterior end of the labrum to the anterior end, mostly following the outline of the outer edge of the labrum, and only becoming obsolete at both ends (Dekkers & Maxwell, 2020, p. 45).

Type Genus. *Dolomena* Wenz, 1940.

Amabiliplicatus Dekkers & Maxwell, 2020

[S. Maxwell, this paper]

nomen cladi conversum

Registration Number. 586

Definition. The maximum clade consisting of *Amabiliplicatus plicatus* (Röding, 1798) and all species that share a more recent common ancestor with them than with *Ministrombus minimus* (Linné, 1771), *Dolomena pulchella* (Reeve, 1851), *Labiostrombus epidromis* (Linné, 1758), *Dominus labiosus* (Wood, 1828), *Pacificus dilatatus* (Swainson, 1821), *Doxander vittatus* (Linné, 1758), *Neodilatilabrum marginatum* (Linné, 1758), *Mirabilistrombus listeri* (Gray, 1852), *Neostrombus fusiformis* (Sowerby II, 1842) or *Laevistrombus vanikorensis* (Quoy & Gaimard, 1834).

Reference Phylogeny. Figure 2 in Dekkers & Maxwell (2020).

Composition. This clade is contained within the *Neostrombinae* (see Maxwell & Rymer (2021) for content) and *Dolomenina* (see Dekkers & Maxwell (2020) for content) and contains the clade *Amabiliplicatus* (see Dekkers & Maxwell (2020) for content). It excludes *Ministrombus* (see Dekkers & Maxwell (2020) for content), *Labiostrombus* (see Dekkers & Maxwell (2020) for content), *Dolomena* (see Dekkers &

Maxwell (2020) for content), *Neostrombinae* (see Dekkers & Maxwell (2020) for content), *Dominus* (see Dekkers & Maxwell (2020) for content), *Pacificus* (see Dekkers & Maxwell (2020) for content), *Conomurex* (see Abbott (1960), for content), *Laevistrombus* (see Maxwell *et al.* (2019a) for content), *Doxanderini* (see Dekkers & Maxwell (2020) for content) and *Neostrombini* (see Liverani *et al.* (2021) for content).

Diagnostic Apomorphies. The spire rather high with shallow knobs and infrequent old varices. The body whorl is broad, with spiral ribbing that becomes coarser towards the anterior end, with small knobs rounded or stretched axially on the rounded shoulder. The shell has a broadly expanded outer lip. The aperture is coarsely lirate within, white or stained with brown. The columellar callous is present but small. The columella is fully lirate, often brown coloured on the lirae. The anterior canal is very short but broad. Strombus notch broad but shallow (Dekkers & Maxwell, 2020, p. 48).

Type Genus. *Amabiliplicatus plicatus* (Röding, 1798).

Dolomena Wenz, 1940
[S. Maxwell, this paper]
nomen cladi conversum

Registration Number. 587

Definition. The maximum clade consisting of *Dolomena pulchella* (Reeve, 1851) and all species that share a more recent common ancestor with them than with *Labiostrombus epidromis* (Linné, 1758), *Ministrombus minimus* (Linné, 1771), *Amabiliplicatus plicatus* (Röding, 1798), *Dominus labiosus* (Wood, 1828), *Pacificus dilatatus* (Swainson, 1821), *Doxander vittatus* (Linné, 1758), *Neodilatilabrum marginatum* (Linné, 1758), *Mirabilistrombus listeri* (Gray, 1852), *Neostrombus fusiformis* (Sowerby II, 1842) or *Laevistrombus vanikorensis* (Quoy & Gaimard, 1834).

Reference Phylogeny. Figure 2 in Dekkers & Maxwell (2020).

Composition. This clade is contained within the *Neostrombinae* (see Maxwell & Rymer (2021) for content) and *Dolomenina* (see Dekkers & Maxwell (2020) for content) and contains the clade *Dolomena* (see Dekkers & Maxwell (2020) for content). It excludes *Ministrombus* (see Dekkers & Maxwell (2020) for content), *Labiostrombus* (see Dekkers & Maxwell (2020) for content), *Amabiliplicatus* (see Dekkers & Maxwell (2020) for content), *Dominus* (see Dekkers & Maxwell (2020) for content), *Pacificus* (see Dekkers & Maxwell (2020) for content), *Doxanderini* (see Dekkers & Maxwell (2020) for content), *Conomurex* (see Abbott (1960), for content), *Laevistrombus* (see Maxwell *et al.* (2019a) for content) and *Neostrombini* (see Liverani *et al.* (2021) for content).

Diagnostic Apomorphies. Shells from 2 cm to 6 cm. Spire with distinct shoulder and with knobs mostly axially aligned. Body whorl with small knobs dorsally and spiral ribbing that can become obsolete. A hardly noticeable second row of very small knobs is present at the mid-whorl, where the outline of the shell has a nick. Expanded outer lip broader at the posterior end and flattened toward the rim. Aperture lirate within, stained with brown colour entering the aperture. Columellar callous present but small on the ventral side, marked, with lirae at the upper half, which are white or brown coloured. A brown background colour is often found deeper within the aperture. Lower half of the columella smooth and with thickened callous. Anterior canal short but always longer than the anterior part of the outer lip. Deeply incised stromboid notch (Dekkers & Maxwell, 2020, p. 45).

Type Genus. *Dolomena pulchella* (Reeve, 1851).

Dominus Dekkers & Maxwell, 2020

[S. Maxwell, this paper]

nomen cladi conversum

Registration Number. 591

Definition. The maximum clade consisting of *Dominus labiosus* (Wood, 1828) and all species that share a more recent common ancestor with them than with *Ministrombus minimus* (Linné, 1771), *Dolomena pulchella* (Reeve, 1851), *Labiostrombus epidromis* (Linné, 1758), *Amabiliplicatus plicatus* (Röding, 1798), *Pacificus dilatatus* (Swainson, 1821), *Doxander vittatus* (Linné, 1758), *Neodilatilabrum marginatum* (Linné, 1758), *Mirabilistrombus listeri* (Gray, 1852), *Neostrombus fusiformis* (Sowerby II, 1842) or *Laevistrombus vanikorensis* (Quoy & Gaimard, 1834).

Reference Phylogeny. Figure 2 in Dekkers & Maxwell (2020).

Composition. This clade is contained within the *Neostrombinae* (see Maxwell & Rymer (2021) for content) and *Dolomenina* (see Dekkers & Maxwell (2020) for content) and contains the clade *Dominus* (see Dekkers & Maxwell (2020) for content). It excludes *Labiostrombus* (see Dekkers & Maxwell (2020) for content), *Dolomena* (see Dekkers & Maxwell (2020) for content), *Neostrombinae* (see Dekkers & Maxwell (2020) for content), *Amabiliplicatus* (see Dekkers & Maxwell (2020) for content), *Ministrombus* (see Dekkers & Maxwell (2020) for content), *Pacificus* (see Dekkers & Maxwell (2020) for content), *Doxanderini* (see Dekkers & Maxwell (2020) for content), *Conomurex* (see Abbott (1960), for content), *Laevistrombus* (see Maxwell *et al.* (2019a) for content), and *Neostrombini* (see Liverani *et al.* (2021) for content).

Diagnostic Apomorphies. The spire with a distinct shoulder and knobs mostly axially aligned. The body whorl has medium knobs dorsally on the shoulder, and weak spiral ribs. The expanded outer lip has a strongly thickened

end. The posterior outer lip is horizontal or pointing slightly upwards to the posterior. The aperture is lirate within. The columellar callous is mostly smooth or weakly lirate. The anterior canal is rather short (Dekkers & Maxwell, 2020, p. 49).

Type Genus. *Dominus labiosus* (Wood, 1828).

Labiostrombus Oostingh, 1925

[S. Maxwell, this paper]

nomen cladi conversum

Registration Number. 600

Definition. The maximum clade consisting of *Labiostrombus epidromis* (Linné, 1758) and all species that share a more recent common ancestor with them than with *Dolomena pulchella* (Reeve, 1851), *Ministrombus minimus* (Linné, 1771), *Amabiliplicatus plicatus* (Röding, 1798), *Dominus labiosus* (Wood, 1828), *Pacificus dilatatus* (Swainson, 1821), *Doxander vittatus* (Linné, 1758), *Neodilatilabrum marginatum* (Linné, 1758), *Mirabilistrombus listeri* (Gray, 1852), *Neostrombus fusiformis* (Sowerby II, 1842) or *Laevistrombus vanikorensis* (Quoy & Gaimard, 1834).

Reference Phylogeny. Figure 2 in Dekkers & Maxwell (2020).

Composition. This clade is contained within the *Neostrombinae* (see Maxwell & Rymer (2021) for content) and *Dolomenina* (see Dekkers & Maxwell (2020) for content) and contains the clade *Labiostrombus* (see Dekkers & Maxwell (2020) for content). It excludes *Ministrombus* (see Dekkers & Maxwell (2020) for content), *Dolomena* (see Dekkers & Maxwell (2020) for content), *Amabiliplicatus* (see Dekkers & Maxwell (2020) for content), *Dominus* (see Dekkers & Maxwell (2020) for content), *Pacificus* (see Dekkers & Maxwell (2020) for content), *Doxanderini* (see Dekkers & Maxwell (2020) for content), *Conomurex* (see Abbott (1960), for content), *Laevistrombus* (see

Maxwell *et al.* (2019a) for content) and *Neostrombini* (see Liverani *et al.* (2021) for content).

Diagnostic Apomorphies. Shell with smooth aperture and columella. The outer lip has a marginal fold and is uniformly calloused towards the edge. The columella is straight. The dorsum has low small knobs or ribs. Spire uniformly sculptured with axial ribs (Dekkers & Maxwell, 2020, p. 46).

Type Genus. *Labiostrombus epidromis* (Linné, 1758).

Ministrombus Dekkers, 2010

[S. Maxwell, this paper]

nomen cladi conversum

Registration Number. 621

Definition. The maximum clade consisting of *Ministrombus minimus* (Linné, 1771) and all species that share a more recent common ancestor with them than with *Dolomena pulchella* (Reeve, 1851), *Labiostrombus epidromis* (Linné, 1758), *Amabiliplicatus plicatus* (Röding, 1798), *Dominus labiosus* (Wood, 1828), *Pacificus dilatatus* (Swainson, 1821), *Doxander vittatus* (Linné, 1758), *Neodilatilabrum marginatum* (Linné, 1758), *Mirabilistrombus listeri* (Gray, 1852), *Neostrombus fusiformis* (Sowerby II, 1842) or *Laevistrombus vanikorensis* (Quoy & Gaimard, 1834).

Reference Phylogeny. Figure 2 in Dekkers & Maxwell (2020).

Composition. This clade is contained within the *Neostrombinae* (see Maxwell & Rymer (2021) for content) and *Dolomenina* (see Dekkers & Maxwell (2020) for content) and contains the clade *Ministrombus* (see Dekkers & Maxwell (2020) for content). It excludes *Labiostrombus* (see Dekkers & Maxwell (2020) for content), *Dolomena* (see Dekkers & Maxwell (2020) for content), *Amabiliplicatus* (see Dekkers & Maxwell (2020) for content), *Dominus* (see

Dekkers & Maxwell (2020) for content), *Pacificus* (see Dekkers & Maxwell (2020) for content), *Doxanderini* (see Dekkers & Maxwell (2020) for content), *Conomurex* (see Abbott (1960), for content), *Laevistrombus* (see Maxwell *et al.* (2019a) for content), and *Neostrombini* (see Liverani *et al.* (2021) for content).

Diagnostic Apomorphies. The spire has a distinct shoulder with knobs. The body whorl is shiny and almost without any sculpture. The expanded outer lip is thickened at the inner edge and is shiny and smooth. The aperture is smooth within. The columellar is smooth, with a well-defined callous. The anterior canal is short. The stromboid notch is medium deep. The posterior canal is present (Dekkers & Maxwell, 2020, p. 47).

Type Genus. *Ministrombus minimus* (Linné, 1771).

Pacificus Dekkers & Maxwell, 2020

[S. Maxwell, this paper]

nomen cladi conversum

Registration Number. 661

Definition. The maximum clade consisting of *Pacificus dilatatus* (Swainson, 1821) and all species that share a more recent common ancestor with them than with *Ministrombus minimus* (Linné, 1771), *Dolomena pulchella* (Reeve, 1851), *Labiostrombus epidromis* (Linné, 1758), *Amabiliplicatus plicatus* (Röding, 1798), *Dominus labiosus* (Wood, 1828), *Doxander vittatus* (Linné, 1758), *Neodilatilabrum marginatum* (Linné, 1758), *Mirabilistrombus listeri* (Gray, 1852), *Neostrombus fusiformis* (Sowerby II, 1842) or *Laevistrombus vanikorensis* (Quoy & Gaimard, 1834).

Reference Phylogeny. Figure 2 in Dekkers & Maxwell (2020).

Composition. This clade is contained within the *Neostrombinae* (see Maxwell & Rymer (2021) for content) and *Dolomenina* (see Dekkers &

Maxwell (2020) for content) and contains the clade *Pacificus* (see Dekkers & Maxwell (2020) for content). It excludes *Labiostrombus* (see Dekkers & Maxwell (2020) for content), *Dolomena* (see Dekkers & Maxwell (2020) for content), *Neostrombinae* (see Dekkers & Maxwell (2020) for content), *Amabiliplicatus* (see Dekkers & Maxwell (2020) for content), *Ministrombus* (see Dekkers & Maxwell (2020) for content), *Dominus* (see Dekkers & Maxwell (2020) for content), *Doxanderini* (see Dekkers & Maxwell (2020) for content), *Conomurex* (see Abbott (1960), for content), *Laevistrombus* (see Maxwell *et al.* (2019a) for content), and *Neostrombini* (see Liverani *et al.* (2021) for content).

Diagnostic Apomorphies. The spire has a distinct (angular) shoulder with knobs axially aligned and spiral ribbing, old varices present. The body whorl has small knobs dorsally and faint spiral ribbing. The outer lip is expanded and flattened towards the edge. The inner lip is calloused at the edge. The aperture is liriate within. The posterior canal is present and bends towards the spire. The columellar callous is well formed, and liriate posteriorly and never coloured. The anterior canal is rather short but broad. Stromboid notch is broad and shallow (Dekkers & Maxwell, 2020, p. 49).

Type Genus. *Pacificus dilatatus* (Swainson, 1821).

Neoaligerinae Maxwell & Rymer, 2021

[S. Maxwell, this paper]

nomen cladi conversum

Registration Number. 568

Definition. The maximum clade consisting of *Aliger gallus* (Linné, 1758), *Euprotomus aurisdiane* (Linné, 1758), *Lambis lambis* (Linné, 1758), *Gibberulus gibberulus* (Linné, 1758), and *Persististrombus granulatus* (Swainson, 1822), and all species that share a more recent common ancestor with them than with

Dolomena pulchellus (Reeve, 1851), *Conomurex luhuanus* (Linné, 1758), *Laevistrombus canarium* (Linné, 1758) or *Neostrombus fusiformis* (Sowerby II, 1842).

Reference Phylogeny. Figure 4 in Maxwell & Rymer (2021).

Composition. A clade containing the two tribes *Persististrombini* (see Maxwell *et al.* (2020) for content) and *Aligerini* (see Maxwell *et al.* (2020) for content) and *Euprotomus* (see Abbott (1960) for content), *Lambis* (see Abbott (1961) for contents), *Gibberulus* (see Abbott (1960) for content). It excludes *Neostrombinae* (see Maxwell & Rymer (2021) for content).

Diagnostic Apomorphies. There are no basal pegs on the radula first latera teeth. Body whorl dorsum often well ornamented with axial chords, knobs or plaits, flaring or ornamented outer lips. The shells are medium to large in size. The posterior canal maybe extended (Maxwell & Rymer, 2021, p. 47).

Type Genus. *Aliger* Thiele, 1929.

Persististrombini Maxwell, Dekkers, Rymer & Congdon, 2020

[S. Maxwell, this paper]

nomen cladi conversum

Registration Number. 662

Definition. A minimum smallest clade containing *Persististrombus granulatus* (Swainson, 1822) and *Thetystrombus latus* (Gmelin, 1791).

Reference Phylogeny. Figure 3 in Maxwell *et al.* (2020).

Composition. The clade contains *Persististrombus* (see Maxwell *et al.* (2020) for content) and *Thetystrombus* (see Maxwell *et al.* (2020) for content).

Diagnostic Apomorphies. A small to medium sized shell with a thin edged outer lip that may be lightly calloused in part. The outer lip is not expanded, and attaches at the shoulder of the body whorl. The sculpture of the aperture wall

is variable, ranging from smooth to granulate. The columella is smooth and calloused anteriorly. The basal sinus is well developed. Shell sculpture with shoulder knobs (Maxwell *et al.* 2020, p. 17).

Type Genus. *Persististrombus* Kronenberg and Lee, 2007.

Persististrombus Kronenberg and Lee, 2007
[S. Maxwell, this paper]
nomen cladi conversum

Registration Number. 663

Definition. The maximum clade consisting of *Persististrombus granulatus* (Swainson, 1822) and *Persististrombus nodosa* (Borson, 1820) and all species that share a more recent common ancestor with them than *Thetystrombus latus* (Gmelin, 1791), *Thetystrombus exbonellii* (Sacco, 1893), *Antestrombus chipolanus* (Dall, 1890) or *Edpetuchistrombus aldrichi* (Dall, 1890).

Reference Phylogeny. Figure 3 in Maxwell *et al.* (2020).

Composition. A clade containing *Persististrombus* (see Maxwell *et al.* (2020) for content). It does not contain *Thetystrombus* (see Maxwell *et al.* (2020) for content), *Aligerina* (see Maxwell *et al.* (2020) for content), *Euprotomus* (see Abbott (1960) for content), *Lambis* (see Abbott (1960) for content) or *Gibberulus* (see Abbott (1960) for content).

Diagnostic Apomorphies. The shell with a sharp outer lip, anteriorly strongly quadrate and not axially reflected. The inner lip is granulated or lirata. The mid-body whorl with rows of nodules. The shell is solid and heavy, with an anterior canal that is reflected (Maxwell *et al.*, 2020, p. 17).

Type Species. *Persististrombus granulatus* (Swainson, 1822).

Thetystrombus Dekkers, 2008
[S. Maxwell, this paper]
nomen cladi conversum

Registration Number. 664

Definition. The maximum clade consisting of *Thetystrombus latus* (Gmelin, 1791) and *Thetystrombus exbonellii* (Sacco, 1893) and all species that share a more recent common ancestor with them than *Persististrombus granulatus* (Swainson, 1822), *Persististrombus nodosa* (Borson, 1820), *Antestrombus chipolanus* (Dall, 1890) or *Edpetuchistrombus aldrichi* (Dall, 1890).

Reference Phylogeny. Figure 3 in Maxwell *et al.* (2020).

Composition. A clade containing *Thetystrombus* (see Maxwell *et al.* (2020) for content). It does not contain *Persististrombus* (see Maxwell *et al.* (2020) for content), *Aligerina* (see Maxwell *et al.* (2020) for content), *Euprotomus* (see Abbott (1960) for content), *Lambis* (see Abbott (1960) for content) or *Gibberulus* (see Abbott (1960) for content).

Diagnostic Apomorphies. The shell with an outer lip that is centrally calloused and not axially reflected; teleoconch with regular nodulations; inner lip smooth; body whorl without striae; shell thin and light; and the anterior canal is straight (Maxwell *et al.*, 2020, p. 18).

Type Species. *Thetystrombus latus* (Gmelin, 1791).

Aligerini Maxwell, Dekkers, Rymer & Congdon, 2020
[S. Maxwell, this paper]
nomen cladi conversum

Registration Number. 665

Definition. A minimum smallest clade containing *Antestrombus chipolanus* (Dall, 1890), *Edpetuchistrombus aldrichi* (Dall, 1890),

Strombus pugilis Linné, 1758 and *Aliger gallus* (Linné, 1758).

Reference Phylogeny. Figure 3 in Maxwell *et al.* (2020).

Composition. The clade contains *Aligerina* *Thetystrombus* (see Maxwell *et al.* (2020) for content) and *Strombina* (see Maxwell *et al.* (2020) for content). It does not contain *Persististrombus* (see Maxwell *et al.* (2020) for content), *Thetystrombus* (see Maxwell *et al.* (2020) for content), *Euprotomus* (see Abbott (1960) for content), *Lambis* (see Abbott (1960) for content) or *Gibberulus* (see Abbott (1960) for content).

Diagnostic Apomorphies. The shell is solid, heavy, with a smooth and calloused outer lip. The body whorl is smooth or with uniform axial sculpture. The basal sinus is variable in depth (Maxwell *et al.* 2020, p. 18).

Type Genus. *Aliger* Thiele, 1929.

Aligerina Maxwell, Dekkers, Rymer & Congdon, 2020

[S. Maxwell, this paper]

nomen cladi conversum

Registration Number. 666

Definition. The maximum clade consisting of *Aliger gallus* (Linné, 1758), *Lobatus raninus* (Gmelin, 1791), *Macrostrombus costatus* (Gmelin, 1791), *Edpetuchistrombus aldrichi* (Dall, 1890), *Titanostrombus goliath* (Schröter, 1805) and all species that share a more recent common ancestor with them than *Thetystrombus latus* (Gmelin, 1791), *Persististrombus granulatus* (Swainson, 1822) or *Antestrombus chipolanus* (Dall, 1890).

Reference Phylogeny. Figure 3 in Maxwell *et al.* (2020).

Composition. A clade containing *Aliger* (see Maxwell *et al.* (2020) for content), *Lobatus* (see Maxwell *et al.* (2020) for content), *Macrostrombus* (see Maxwell *et al.* (2020) for content), *Edpetuchistrombus* (see Maxwell *et al.*

(2020) for content), *Titanostrombus goliath* (see Maxwell *et al.* (2020) for content). It does not contain *Persististrombus* (see Maxwell *et al.* (2020) for content), *Thetystrombus* (see Maxwell *et al.* (2020) for content), Maxwell *et al.* (2020) for content), *Euprotomus* (see Abbott (1960) for content), *Lambis* (see Abbott (1960) for content) or *Gibberulus* (see Abbott (1960) for content).

Diagnostic Apomorphies. The shell is heavy and moderately large with a broad outer lip that is calloused and thickened. The basal sinus is present (Maxwell *et al.*, 2020, p. 18).

Type Genus. *Aliger* Thiele, 1929.

Aliger Thiele, 1929

[S. Maxwell, this paper]

nomen cladi conversum

Registration Number. 667

Definition. The maximum clade consisting of *Aliger gallus* (Linné, 1758) and all species that share a more recent common ancestor with them than *Lobatus raninus* (Gmelin, 1791), *Macrostrombus costatus* (Gmelin, 1791), *Edpetuchistrombus aldrichi* (Dall, 1890), *Titanostrombus goliath* (Schröter, 1805), *Antestrombus chipolanus* (Dall, 1890), *Strombus pugilis* Linné, 1758 or *Persististrombus granulatus* (Swainson, 1822).

Reference Phylogeny. Figure 3 in Maxwell *et al.* (2020).

Composition. A clade within *Aligerini* (see Maxwell *et al.* (2020) for content) that contains *Aliger* (see Maxwell *et al.* (2020) for content). It does not contain *Lobatus* (see Maxwell *et al.* (2020) for content), *Macrostrombus* (see Maxwell *et al.* (2020) for content), *Edpetuchistrombus* (see Maxwell *et al.* (2020) for content), *Titanostrombus* *Antestrombus* (see Maxwell *et al.* (2020) for content) or *Strombus* (see Maxwell *et al.* (2020) for content).

Diagnostic Apomorphies. The shell outer lip is inflated, with widely, expanded, uniformly

thickened lips as adults, but is not axially reflected; posterior end of lip narrowing to projection or point, giving the aperture a triangulate shape; shoulders often ornamented with large knobs; shell moderately heavy and solid; and an anterior canal that is reflected (Maxwell *et al.*, 2020, p. 18).

Type Species. *Aliger gallus* (Linné, 1758).

Lobatus Iredale, 1921
[S. Maxwell, this paper]
nomen cladi conversum

Registration Number. 668

Definition. The maximum clade consisting of *Lobatus raninus* (Gmelin, 1791) and all species that share a more recent common ancestor with them than *Aliger gallus* (Linné, 1758), *Macrostrombus costatus* (Gmelin, 1791), *Edpetuchistrombus aldrichi* (Dall, 1890), *Titanostrombus goliath* (Schröter, 1805), *Antestrombus chipolanus* (Dall, 1890), *Strombus pugilis* Linné, 1758 or *Persististrombus granulatus* (Swainson, 1822).

Reference Phylogeny. Figure 3 in Maxwell *et al.* (2020).

Composition. A clade within *Aligerini* (see Maxwell *et al.* (2020) for content) that contains *Lobatus* (see Maxwell *et al.* (2020) for content). It does not contain *Aliger* (see Maxwell *et al.* (2020) for content), *Macrostrombus* (see Maxwell *et al.* (2020) for content), *Edpetuchistrombus* (see Maxwell *et al.* (2020) for content), *Titanostrombus* (see Maxwell *et al.* (2020) for content), *Antestrombus* (see Maxwell *et al.* (2020) for content) or *Strombus* (see Maxwell *et al.* (2020) for content).

Diagnostic Apomorphies. The shell is triangulate, heavy and solid; outer lip axially reflected and posteriorly tricornate with uniform callosity; mid-dorsal body whorl with striae and rows of nodules; and the anterior canal is reflected (Maxwell *et al.*, 2020, p. 19).

Type Species. *Lobatus raninus* (Gmelin, 1791).

Macrostrombus Petuch, 1994

[S. Maxwell, this paper]

nomen cladi conversum

Registration Number. 669

Definition. The maximum clade consisting of *Macrostrombus costatus* (Gmelin, 1791) and all species that share a more recent common ancestor with them than *Aliger gallus* (Linné, 1758), *Lobatus raninus* (Gmelin, 1791), *Edpetuchistrombus aldrichi* (Dall, 1890), *Titanostrombus goliath* (Schröter, 1805), *Antestrombus chipolanus* (Dall, 1890), *Strombus pugilis* Linné, 1758 or *Persististrombus granulatus* (Swainson, 1822).

Reference Phylogeny. Figure 3 in Maxwell *et al.* (2020).

Composition. A clade within *Aligerini* (see Maxwell *et al.* (2020) for content) that contains *Macrostrombus* (see Maxwell *et al.* (2020) for content). It does not contain *Aliger* (see Maxwell *et al.* (2020) for content), *Edpetuchistrombus* (see Maxwell *et al.* (2020) for content), *Titanostrombus* (see Maxwell *et al.* (2020) for content), *Antestrombus* (see Maxwell *et al.* (2020) for content) or *Strombus* (see Maxwell *et al.* (2020) for content).

Diagnostic Apomorphies. The shell dorsum with uniform striae; teleoconch whorls knobbed; body whorl with shoulder nodulations; outer lip centrally calloused, posteriorly quadrate and thinned; outer lip edge axially reflected with glazing; aperture smooth; shell heavy and solid and an anterior canal that is reflected (Maxwell *et al.*, 2020, p. 19).

Type Species. *Macrostrombus costatus* (Gmelin, 1791).

Edpetuchistrombus Maxwell, Dekkers, Rymer,
& Congdon 2020
[S. Maxwell, this paper]
nomen cladi conversum

Registration Number. 670

Definition. The maximum clade consisting of *Edpetuchistrombus aldrichi* (Dall, 1890) and all species that share a more recent common ancestor with them than *Aliger gallus* (Linné, 1758), *Lobatus raninus* (Gmelin, 1791), *Macrostrombus costatus* (Gmelin, 1791), *Titanostrombus goliath* (Schröter, 1805), *Antestrombus chipolanus* (Dall, 1890), *Strombus pugilis* Linné, 1758 or *Persististrombus granulatus* (Swainson, 1822).

Reference Phylogeny. Figure 3 in Maxwell *et al.* (2020).

Composition. A clade within *Aligerini* (see Maxwell *et al.* (2020) for content) that contains *Edpetuchistrombus* (see Maxwell *et al.* (2020) for content). It does not contain *Aliger* (see Maxwell *et al.* (2020) for content), *Lobatus* (see Maxwell *et al.* (2020) for content), *Titanostrombus* (see Maxwell *et al.* (2020) for content), *Antestrombus* (see Maxwell *et al.* (2020) for content) or *Strombus* (see Maxwell *et al.* (2020) for content).

Diagnostic Apomorphies. Shells of moderate size; ovate; spire with spiral lines and knobs; body whorls with evenly spaced spiral ribbing that run also on the relatively large shoulder knobs; lip flaring, aperture straight, not glazed within; aperture extends posteriorly before the pre-ultimate whorl. The spiral ribbing runs over the extended lip, bending backwards. Apertural rim not glazed. The anterior canal not broad and a little reflected to the left. The Stromboid notch is present but shallow (Maxwell *et al.*, 2020, p. 20).

Type Species. *Edpetuchistrombus aldrichi* (Dall, 1890).

Titanostrombus Petuch, 1994
[S. Maxwell, this paper]
nomen cladi conversum

Registration Number. 671

Definition. The maximum clade consisting of *Titanostrombus goliath* (Schröter, 1805) and all species that share a more recent common ancestor with them than *Aliger gallus* (Linné, 1758), *Lobatus raninus* (Gmelin, 1791), *Macrostrombus costatus* (Gmelin, 1791), *Antestrombus chipolanus* (Dall, 1890), *Edpetuchistrombus aldrichi* (Dall, 1890), *Strombus pugilis* Linné, 1758 or *Persististrombus granulatus* (Swainson, 1822).

Reference Phylogeny. Figure 3 in Maxwell *et al.* (2020).

Composition. A clade within *Aligerini* (see Maxwell *et al.* (2020) for content) that contains *Titanostrombus* (see Maxwell *et al.* (2020) for content). It does not contain *Aliger* (see Maxwell *et al.* (2020) for content), *Lobatus* (see Maxwell *et al.* (2020) for content), *Edpetuchistrombus* (see Maxwell *et al.* (2020) for content), *Antestrombus* (see Maxwell *et al.* (2020) for content) or *Strombus* (see Maxwell *et al.* (2020) for content).

Diagnostic Apomorphies. The shell outer lip is uniformly thin on the border, thickened centrally, expanded and rounded posteriorly; body whorl sculptured with broad narrow interspaced ribs; teleoconch often with large knobs; knobs become obsolete on body whorl; shell moderately heavy and solid; and an anterior canal that is reflected (Maxwell *et al.*, 2020, p. 21).

Type Species. *Titanostrombus goliath* (Schröter, 1805).

Strombina Maxwell, Dekkers, Rymer, Congdon
& Maxwell, 2020

[S. Maxwell, this paper]

nomen cladi conversum

Registration Number. 672

Definition. The maximum clade consisting of *Antestrombus chipolanus* (Dall, 1890) and *Strombus pugilis* Linné, 1758 and all species that share a more recent common ancestor with them than *Edpetuchistrombus aldrichi* (Dall, 1890), *Thetystrombus latus* (Gmelin, 1791) or *Persististrombus granulatus* (Swainson, 1822).

Reference Phylogeny. Figure 3 in Maxwell *et al.* (2020).

Composition. A clade containing *Antestrombus* (see Maxwell *et al.* (2020) for content, and *Strombus* (see Maxwell *et al.* (2020). It does not contain *Persististrombini* (see Maxwell *et al.* (2020) for content), *Aligerina* (see Maxwell *et al.* (2020) for content), Maxwell *et al.* (2020) for content), *Euprotomus* (see Abbott (1960) for content), *Lambis* (see Abbott (1960) for content) or *Gibberulus* (see Abbott (1960) for content).

Diagnostic Apomorphies. Shells biconic with the apertural rim not glazed. The edge of lip somewhat thickened posteriorly and calloused, becoming thinner and sharper anteriorly (Maxwell *et al.*, 2020, p. 21).

Type Genus. *Strombus* Linné, 1758.

Antestrombus Maxwell, Dekkers, Rymer,
Congdon & Maxwell, 2020

[S. Maxwell, this paper]

nomen cladi conversum

Registration Number. 673

Definition. The maximum clade consisting of *Antestrombus chipolanus* (Dall, 1890) and all species that share a more recent common ancestor with them than *Edpetuchistrombus aldrichi* (Dall, 1890), *Strombus pugilis* Linné, 1758 or *Persististrombus granulatus* (Swainson, 1822).

Reference Phylogeny. Figure 3 in Maxwell *et al.* (2020).

Composition. A clade within *Strombina* (see Maxwell *et al.* (2020) for content) that contains *Antestrombus* (see Maxwell *et al.* (2020) for content). It does not contain *Aligerina* (see Maxwell *et al.* (2020) for content) or *Strombus* (see Maxwell *et al.* (2020) for content).

Diagnostic Apomorphies. Shells of moderate size. Spire acute, with spiral lines and axially aligned knobs. Body whorl reversed conoidal form. The body whorl has evenly spaced spiral ribbing that is almost smooth, with relatively large and sharp shoulder knobs. The non-flaring lip with a straight side. The aperture large but narrow and not extending posteriorly before the body whorl. The spiral ribbing runs over the extended lip and bends slightly backwards at the posterior end. The apertural rim not glazed but a little thickened by shell material added from the inside of the aperture. Inside outer lip smooth. The anterior canal not broad, but deep, and slightly reflected to the left. Stromboid notch present but shallow. (Maxwell *et al.*, 2020, p. 21).

Type Species. *Antestrombus chipolanus* (Dall, 1890).

Strombus Linné, 1758

[S. Maxwell, this paper]

nomen cladi conversum

Registration Number. 674

Definition. The maximum clade consisting of *Strombus pugilis* Linné, 1758 and all species that share a more recent common ancestor with them than *Edpetuchistrombus aldrichi* (Dall, 1890), *Antestrombus chipolanus* (Dall, 1890) or *Persististrombus granulatus* (Swainson, 1822).

Reference Phylogeny. Figure 3 in Maxwell *et al.* (2020).

Composition. A clade within *Strombina* (see Maxwell *et al.* (2020) for content) that contains *Strombus* (see Maxwell *et al.* (2020) for

content). It does not contain *Aligerina* (see Maxwell *et al.* (2020) for content) or *Antestrombus* (see Maxwell *et al.* (2020) for content).

Diagnostic Apomorphies. Shells of moderate size. Spire acute, with spiral lines and axially aligned knobs. Body whorl reversed conoidal form. The body whorl has evenly spaced spiral ribbing that is almost smooth, with relatively large and sharp shoulder knobs. The non-flaring lip with a straight side. The aperture large but narrow and not extending posteriorly before the body whorl. The spiral ribbing runs over the extended lip and bends slightly backwards at the posterior end. The apertural rim not glazed but a little thickened by shell material added from the inside of the aperture. Inside outer lip smooth. The anterior canal not broad, but deep, and slightly reflected to the left. Stromboid notch present but shallow (Maxwell *et al.*, 2020, p. 21).

Type Species. *Strombus pugilis* Linné, 1758.

ERRATA Maxwell & Rymer (2021) The Festivus 53(1):

- 1) In the title “Stromboidae” should read “Strombidae”
- 2) The allocation of the type genus for Neostrombinae: “Type Genus. *Canarium* Schumacher, 1817” should read “Type Genus. *Neostrombus* Liverani, Dekkers & Maxwell, 2021”

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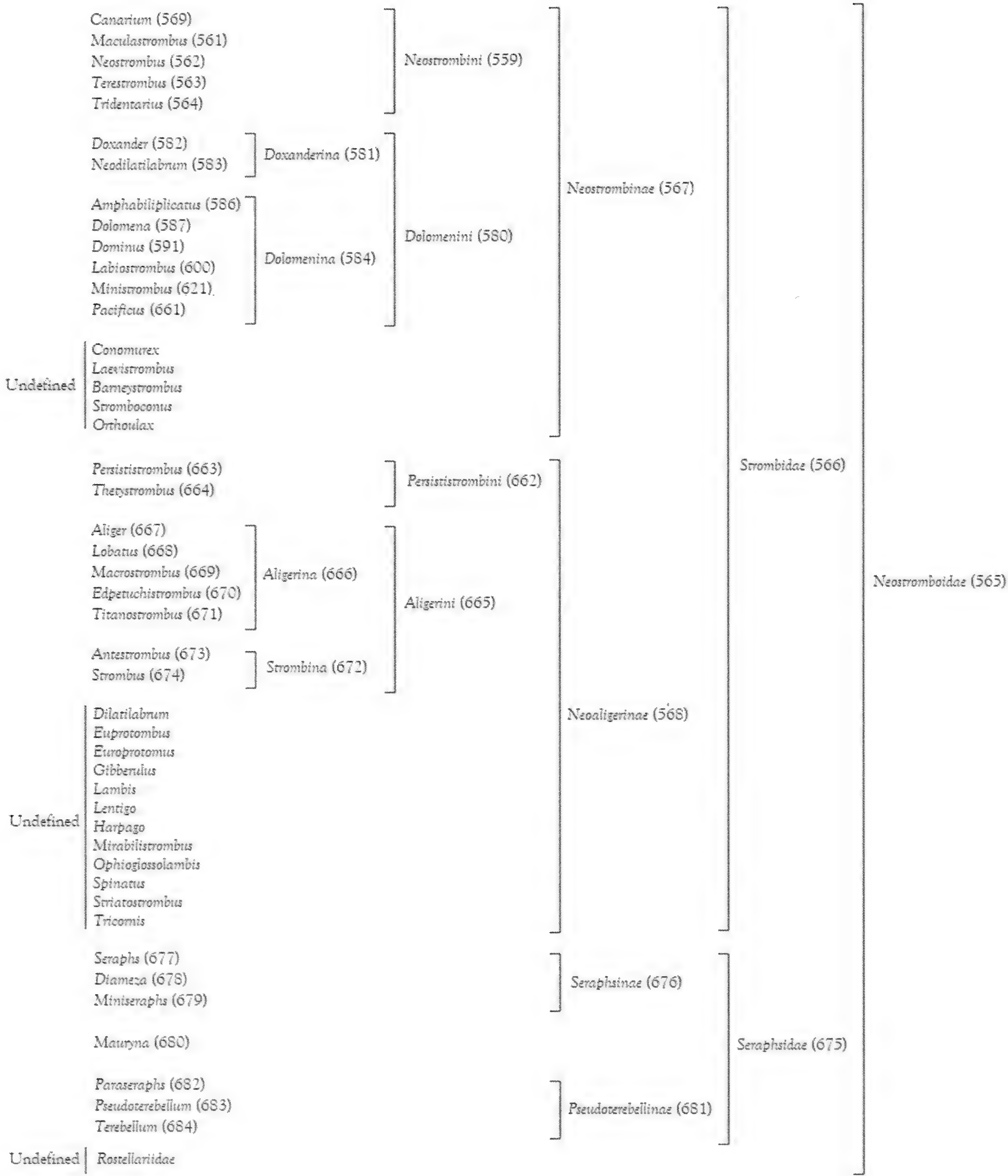


Figure 1. The defined clades within *Neostromboidae* defined within this paper and including those defined clades within *Seraphsidae* which have been described in Maxwell *et al.* 2021 showing their cladistic relationships. Those taxa within the *Neostromboidae* that have not been defined are included with provisional placements indicated. RegNum numbers for the currently defined taxa are shown in brackets after each taxon name.

Description of four new *Nataliamarginella* and one *Punctamarginella* species (Marginellidae: *Marginella*), from the Eastern Cape, South Africa

Stephan G. Veldsman

Institute for Marine and Environmental Science, Pretoria, South Africa

conus@enviromarine.co.za

ABSTRACT Five new species in the genus *Marginella* from the Eastern Cape, South Africa are described. Four species in the subgenus *Nataliamarginella* S.G. Veldsman, 2017: *M. (N.) mbasheensis* n. sp., *M. (N.) mlambomkuluensis* n. sp., *M. (N.) mtataensis* n. sp., and *M. (N.) muratovi* n. sp.; and one species in the subgenus *Punctamarginella* S.G. Veldsman, 2017 *M. (P.) transovula* n. sp. The new species are compared to their closest congeners within their respective subgenus with regards to their shell morphological features and locality. The species described here are all found deep water (50-550 m) along the central-northern Eastern Cape, between the Great Kei River (50 km north of East London) and Mbotyi (25 km north of Port St. Johns), South Africa, a portion of the region previously known as Transkei. Most of the closest congeners regarding shell morphology are found in KwaZulu-Natal at least 70 km north-east and further, with a region previously named Pondoland separating them. Very few *Marginella* species are adapted to live in the specific habitat of the Pondoland region.

KEYWORDS *Marginella*, *Nataliamarginella*, *Punctamarginella*, Marginellidae, Eastern Cape, South Africa

INTRODUCTION

Several research programs were conducted by the Natal Museum, Pietermaritzburg, during the 1980s. Most of these were commanded by the R.V. Meiring Naudé research vessel, dredging the sea-bed, collecting and cataloging everything found. Many shells were collected during these dredging's at depths ranging from 60 to 550 m. Numerous of these are yet to be described, such as the five species discussed here.

Four of the species described here belong to the Marginellid subgenus *Nataliamarginella* S.G. Veldsman, 2017, characterized by small to moderately large species (8-40 mm), obconic to slightly elongated with fairly rounded shoulders. The spire is usually high, slightly stepped to very stepped. The aperture is narrow to

moderately wide, callus present on the columella and has no posterior notch or labial denticles. The four new *Nataliamarginella* species are: *M. (N.) mbasheensis* n. sp., *M. (N.) mlambomkuluensis* n. sp., *M. (N.) mtataensis* n. sp., and *M. (N.) muratovi* n. sp. Each of them will be compared to their closest related congener under each species description.

The fifth species described here belong to the subgenus *Punctamarginella* S.G. Veldsman, 2017, characterized by small (6-13 mm), conical shaped species with a low spire. Shells have a thick labrum, strongly developed posterior notch and labial denticles. The aperture is moderately wide to narrow with callus on the columella. The new *Punctamarginella* species is: *M. (P.) transovula*, and compared to several closely related species.

The species within both these two subgenera were mainly known from KwaZulu-Natal with few species occurring in Mozambique (Veldsman 2017, 2019). More recently Aiken (2019) described a new species from the northern parts of the Eastern Cape, *Marginella xoraensis* Aiken, 2019 that are designated here to belong to the subgenus *Nataliamarginella*. The five species described here are all found in deep water (50-550 m) along the central-northern Eastern Cape, between the Great Kei River (50 km north of East London) and Mbotyi (25 km north of Port St. Johns), South Africa (Figure 1), a portion of the region previously known as Transkei. The larger river systems inland along this piece of coast have large catchment areas flowing over Karoo sedimentary rocks, and subsequently depositing high volumes of sediments into the ocean (Veldsman 2019). Although it has a relatively narrow coastline, the large amounts of sediment form sufficient sandy strata for the habitat of the *Marginella* species (Veldsman 2019). A large biodiversity of *Marginella* species occurs in this area.

Further north of Mbotyi up to the Mzamba River, just south of Port Edward the region previously known as Pondoland is situated. The coast along Pondoland is associated with hard rock and high cliffs. The continental slope is extremely steep with gradients up to 12° reflecting structural geological control of this area since the break-up of the western Gondwana landmass some 25 to 30 million years before the present (Scrutton & Du Plessis 1973; Dingle & Scrutton 1974). Flemming (1978) reports that the seabed consists of a smooth, continuous sand sheet that is occasionally interrupted by rocky outcrops. The continental shelf along this stretch of coast is further characterised by many submarine canyons (Green *et al.* 2009), providing natural marine ecosystem breaks. Hence, no sand dune systems can form along this stretch of coastline, and there are very few areas that have suitable habitat for *Marginella* species. Only a few *Marginella* species are adapted to inhabit these smaller sand pockets between the rocks. North of Mzamba River, in southern KwaZulu-Natal the habitat is much more suitable for *Marginella* species (Veldsman 2019), and is well known for the high biodiversity of species occurring there.

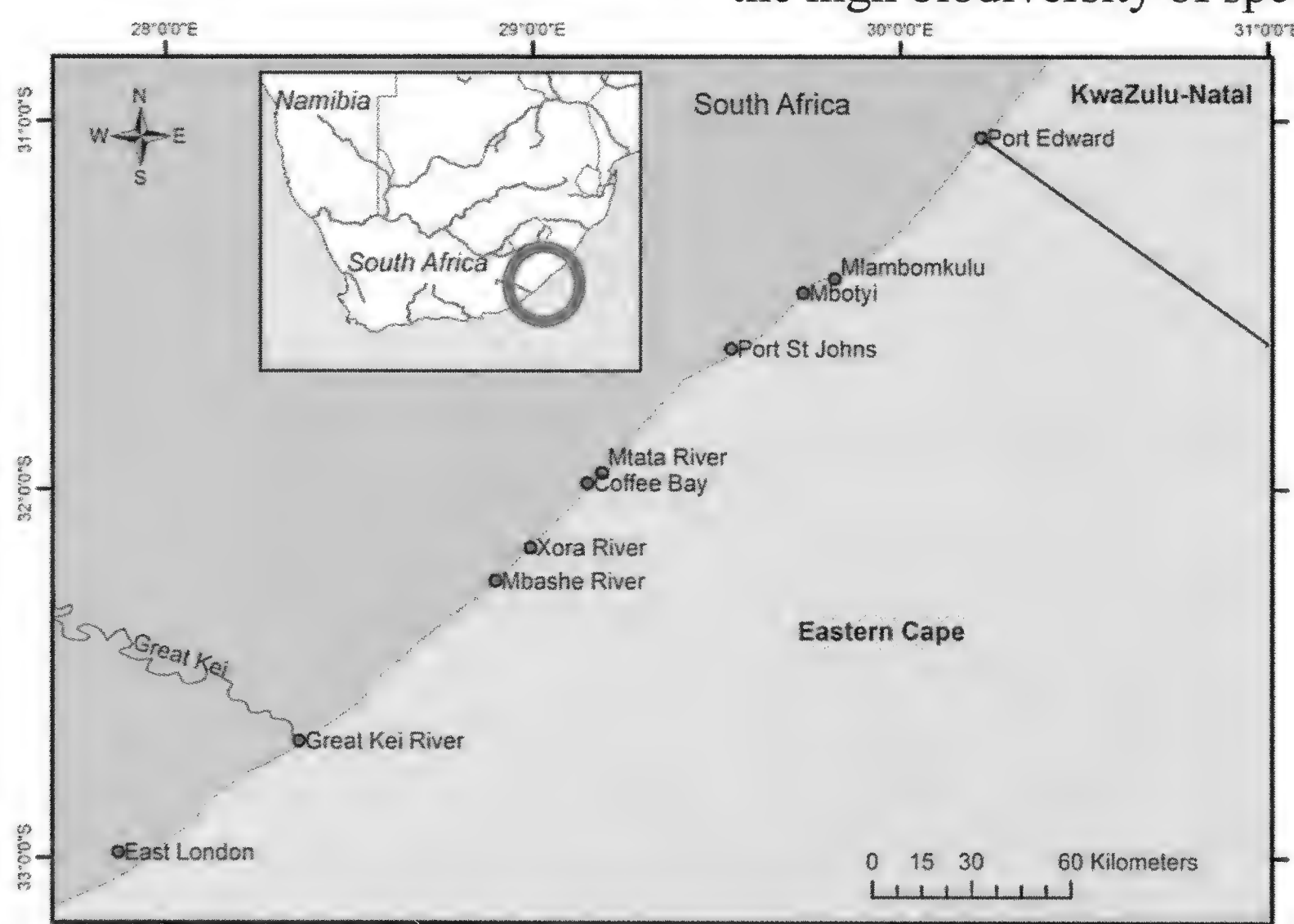


Figure 1. Locality map indicating the region where the five new species occur, Eastern Cape, South Africa.

METHODS

Marginella species have a very narrow habitat-specific distributional range along the South African coast, and are found in very shallow waters up to depths of about 600 meters. Therefore, they are found mainly in areas with a sandy substrate, mud-flats, or sandbanks, large enough to sustain a population. Thus, the locality, together with shell morphological characteristics are useful in the grouping and describing species (Veldsman 2019).

Many taxonomic characters define *Marginella* species, where species within the same subgenus share several of these, such as the type of labial denticles, posterior notch and callus on columella. Other shell morphological features are used here to differentiate species from each other, but not limited to, such as the shoulder shape and width, general shape of the shell, spire height and characteristics, aperture shape and width, shape of the labrum, markings, coloration and striae on body whorl. Further to the shell morphological features, location is very important as noted before, *Marginella* species are very localized and sometimes biogeographically separated from each other.

Shells larger than 16 mm were measured with a pair of digital calipers (RS Pro Electronic Digital Caliper 150mm/6", South Africa). To ensure precision, each measurement was taken in triplicate. Shells smaller than 16 mm were photographed using an Olympus SZ61 microscope (SC100 Olympus camera, Münster, Germany) and digitally measured (Stream Imaging Software, Olympus). All the type material of the new species were photographed by the author at the Natal Museum.

SYSTEMATICS

Phylum Mollusca Linnaeus, 1758
 Class Gastropoda Cuvier, 1795
 Subclass Caenogastropoda Cox, 1960
 Order Neogastropoda Wenz, 1938
 Superfamily Volutoidae Rafinesque, 1815
 Family Marginellidae Fleming, 1828
 Genus *Marginella* Lamarck, 1799
 Subgenus *Nataliamarginella* Veldsman, 2017
 Subgenus *Punctamarginella* Veldsman, 2017

Marginella (Nataliamarginella) mbasheensis
 S.G. Veldsman, n. sp.
 (Figures 2.1, 2.2, 2.3, 2.5, 2.6 & 2.7)

Description. The shell is small (10-12 mm), elongated ovate-biconical shaped, has a low angled rounded shoulder. Has a thick labrum, smooth and off-white colored, with no posterior notch or labial denticles. Callus is highly developed on the columella. Spire low and broad, spire whorls convex and slightly stepped. Wide protoconch, off-white to light grey color. Columella rather straight with four thick continuous plications, which take up half the length of the aperture, off-white color. Aperture narrow and straight, off-white color. Background color of dorsum of the body whorl off-white to light creamy colored. Body whorl has vague, very thin, light colored creamy to light grey lines around the body whorl, occurring from the shoulder to the lower third, followed by a broad clear off-white band, then by a thin darker brown to grey colored band, followed again by vague, very thin, light colored creamy to light grey lines towards the base (anterior side) of the shell. No lines or markings visible on shoulder, spire whorls or the labrum.

Distribution. Type locality of *M. (N.) mbasheensis* n. sp. is dredged 295-350m off Mbashe River, approx. 36 km south-west of

Coffee Bay, Eastern Cape, South Africa. All specimens studied occur between the Great Kei River and Coffee Bay in deep water ranging from 240-370m depth.

Type material. The type material of the holotype and paratypes of *M. (N.) mbasheensis* are as follows:

Holotype: 10.95 x 5.97 mm (Figure 2.1); off Mbashe River (32°23.6'S & 28°59.2'E), approx. 36 km south-west of Coffee Bay, dredged 295-350 m, 1985; Coll. Natal Museum South Africa (NMSA), ID No: P1477/T4439.

Paratype 1: 10.48 x 6.09 mm (Figure 2.2); off Mbashe River (32°23.6'S & 28°59.2'E), dredged 295-350 m, 1985; Coll. NMSA: P1478/T4440.

Paratype 2: 11.39 x 5.87 mm (Figure 2.3); off Bulungulu River (32°14.2'S & 29°08.6'E), approx. 22 km south-west of Coffee Bay, dredged 300-370 m, 1985; Coll. NMSA: C8548/T4441.

Paratype 3: 11.11 x 5.95 mm (Figure 2.5); off Nqabara Point (32°25.0'S & 28°58.3'E), approx. 44 km south-west of Coffee Bay, dredged 330-340 m, 1984; Coll. NMSA: C6445/T4442.

Paratype 4: 11.76 x 6.31 mm (Figure 2.6); off Shixini Point (32°31.4'S & 28°51.9'E), approx. 35 km north-east of the Great Kei River, dredged 240 m, 1984; Coll. NMSA: C6332/T4443.

Paratype 5: 12.12 x 6.46 mm; off Shixini Point (32°31.4'S & 28°51.9'E), dredged 240 m, 1984; Coll. NMSA: P1479/T4444.

Paratype 6: 11.75 x 6.07 mm (Figure 2.7); off Shixini Point (32°31.4'S &

28°51.9'E), dredged 240 m, 1984; Coll. NMSA: P1480/T4445.

Paratype 7: 10.88 x 5.89 mm; off Mendu Point (32°24.0'S & 28°59.0'E), approx. 45 km south-west of Coffee Bay, dredged 250 m, 1984; Coll. NMSA: C6278/T4446.

Paratype 8: 11.90 x 6.25 mm; off Mendu Point (32°24.0'S & 28°59.0'E), dredged 250 m, 1984; Coll. NMSA: P1481/T4447.

Paratype 9: 10.09 x 5.76 mm; off Mendu Point (32°24.0'S & 28°59.0'E), dredged 250 m, 1984; Coll. NMSA: P1482/T4448.

Paratype 10: 11.41 x 5.91 mm; off Bulungulu River (32°14.2'S & 29°08.6'E), dredged 300-370 m, 1985; Coll. NMSA: P1483/T4449.

Paratype 11: 8.66 x 4.59 mm, Juvenile; off Mbashe River (32°23.6'S & 28°59.2'E), dredged 295-350 m, 1985; Coll. NMSA: C9129/T4450.

Etymology. *Marginella (N.) mbasheensis* n. sp. is named for the Mbashe River, approx. 67 km north-east of the Great Kei River and 36 km south-west of Coffee Bay (Figure 1).

Discussion. *Marginella (N.) mbasheensis* n. sp. is a very distinct species and is not closely related to any of the other species in the subgenus, except maybe the color bands around the body whorl compare to that of *M. (N.) natalcinerea* Massier, 1993 (Figure 2.4). The latter species however is much larger and has a higher spire, and occur very far north-east (more than 300 km) on the Tugela Bank, north of Durban, KwaZulu-Natal, in a totally different habitat.

Marginella (Nataliamarginella) mtataensis

S.G. Veldsman, n. sp.

(Figures 3.1, 3.2 & 3.3)

Description. The shell is small (10-12 mm), ovate-biconical shaped, has a low angled rounded shoulder. Thick labrum, smooth and off-white background color with dark brown markings on top, with no posterior notch or labial denticles. Spire low and broad, spire whorls convex and slightly stepped. Wide protoconch, light grey color. Columella straight with four thick continuous plications, which take up half the length of the aperture, off-white color. Callus developed on the columella. Aperture narrow and straight, off-white color. Background color of dorsum of the body whorl off-white colored. Background of the body whorl off-white to creamy colored, with brown speckled pattern presented in thin bands around the body whorl. The thin speckled lines become lighter colored towards the last third of the body whorl at anterior side, presented as a wide band, followed by dark brown lines. These dark brown lines are presented as a wide band, mainly visible on aperture side. The last portion towards the base of the shell have similar speckled bands than that of the first two thirds of the shell. The shoulder has a darker speckled band presented as larger blocks. The spire has brown speckled bands similar to that found around the body whorl.

Distribution. Type locality of *M. (N.) mtataensis* n. sp. is dredged 135-165 m off Ubombo, approx. 10 km north-east of Coffee Bay, nearly across the Mtata River, Eastern Cape, South Africa. All specimens studied occur between Port St. Johns and the Great Kei River, in deep water ranging from 130-165 m depth.

Type material. The type material of the holotype and paratypes of *M. (N.) mtataensis* are as follows:

Holotype: 10.68 x 5.82 mm (Figure 3.1); off Ubombo (31°57.4'S & 29°23.5'E), dredged 135-165 m, 1982; Coll. Natal Museum South Africa (NMSA), ID No: C3280/T4454.

Paratype 1: 10.62 x 5.76 mm (Figure 3.2); off Nthlonyane, approx. 7 km north-east of Mbashe River, approx. 30 km south-west of Coffee Bay (32°17.08'S & 29°03.15'E), dredged 130 m, 1982; Coll. NMSA: P1485/T4455.

Paratype 2: 11.24 x 6.15 mm (Figure 3.3); off Nthlonyane (32°17.08'S & 29°03.15'E), dredged 130 m, 1982; Coll. NMSA: P1486/T4456.

Paratype 3: 10.57 x 5.26 mm; off Nthlonyane (32°17.08'S & 29°03.15'E), dredged 130 m, 1982; Coll. NMSA: P1487/T4457.

Etymology. *Marginella (N.) mtataensis* n. sp. is named for the Mtata River, approx. 10 km north-east of Coffee Bay, Eastern Cape (Figure 1).

Discussion. *Marginella (N.) mtataensis* n. sp. is closely related and very similar in size to *M. (N.) parkrynieensis* J.H. Veldsman & S.G. Veldsman, 2012 (Figures 3.6 & 4.6) and *M. (N.) wallaceorum* Lussi, 2013 (Figures 3.4 & 3.5). *Marginella (N.) mtataensis* is slightly narrower than *M. (N.) wallaceorum*, not as ovate in shape, and slightly more curved at the anterior end. *Marginella (N.) mtataensis* is slightly smaller in size than *M. (N.) parkrynieensis*, where *M. (N.) parkrynieensis* is straighter in general shape, with a shorter spire length in relation to shell

length than *M. (N.) mtataensis*. One main shell morphological feature differentiating *M. (N.) mtataensis* from the other two is that its aperture is narrower and straighter. Another point differentiating *M. (N.) mtataensis* is biogeographical, as the habitat of this species is at least 80 km south-west from the southern KwaZulu-Natal two species (*M. (N.) wallaceorum* and *M. (N.) parkrynieensis*, with Pondoland separating them where none of the three species occur there.

Marginella (Nataliamarginella)
mlambomkuluensis S.G. Veldsman, n. sp.
(Figures 4.1, 4.2 & 4.3)

Description. The shell is small (13-14 mm), elongated ovate-biconical shaped, has a low angled rounded shoulder. Has a thick labrum, smooth and off-white background color with dark brown markings on top, with no posterior notch or labial denticles. Spire high and moderately broad, spire whorls convex and slightly stepped. Wide protoconch, off-white to light grey color. Callus is highly developed on the columella. Columella rather straight with four thick continuous plications, which take up half the length of the aperture, off-white color. Aperture narrow and straight, off-white color. Background of the body whorl off-white to creamy colored, with brown speckled pattern presented in thin bands around the body whorl. The thin speckled lines become lighter colored, presented as a wide band below the shoulder and towards the last third of the body whorl, followed by a wide dark brown line around the body whorl towards the anterior side. The last portion towards the base (anterior side) of the shell have similar speckled bands than the first two thirds of the shell. The shoulder has a darker speckled band presented as larger blocks or flecks. The spire has brown speckled bands similar to that around the body whorl.

Distribution. Type locality of *M. (N.) mlambomkuluensis* n. sp. is dredged 200 m off Mbotyi, Eastern Cape, South Africa. All specimens studied occur from just north of Mbotyi to around Coffee Bay, in deep water ranging from 200-280 m depth.

Type material. The type material of the holotype and paratypes of *M. (N.) mlambomkuluensis* are as follows:

Holotype: 14.33 x 7.12 mm (Figure 4.1); off Mbotyi (31°33.0'S & 29°51.8'E), dredged 200 m, 1986; Coll. Natal Museum South Africa (NMSA), ID No: C9750/T4451.

Paratype 1: 13.76 x 6.96 mm (Figure 4.2); off Waterfall Bluff (31°30.1'S & 29°55.7'E), dredged 230-250 m, 1986; Coll. NMSA: C9857/T4452.

Paratype 2: 13.68 x 6.69 mm (Figure 4.3); off Whale Rock (32°02.9'S & 29°19.7'E), dredged 250-280 m, 1985; Coll. NMSA: P1484/T4453.

Etymology. *Marginella (N.) mlambomkuluensis* n. sp. is named for the Mlambomkulu River, approx. 34 km north-east of Port St. Johns and approx. 9 km north-east of Mbotyi (Figure 1) that forms the Waterfall Bluff. The Waterfall Bluff is one of the few places in the world where the river forms a waterfall that falls straight into the ocean.

Discussion. *Marginella (N.) mlambomkuluensis* n. sp. compare to *M. (N.) gracilenta* S.G. Veldsman, 2015 (Figures 4.4, 4.5 & 4.7) with general shape and size, however the latter species has a higher spire and the body whorl is slimmer. *Marginella (N.) mlambomkuluensis* n. sp. has a straighter aperture than *M. (N.) gracilenta* and the coloration on the body whorl

is different than the pattern of the body whorl of *M. (N.) gracilenta* that consists of fine dotted lines with no prominent bands around body whorl. The two species are further separated by Pondoland, at least 70 km of coast, with *M. (N.) gracilenta* occurring only in southern KwaZulu-Natal.

Marginella (Nataliamarginella) muratovi
S.G. Veldsman, n. sp.
(Figures 5.1, 5.2 & 5.3)

Description. The shell is moderately large (17-22 mm), biconical shaped, has a moderately angled rounded shoulder. Has a thick labrum, smooth and off-white background color with markings dark brown markings on top, with no posterior notch or labial denticles. Callus is highly developed on the columella. Spire high and sharp, spire whorls convex and stepped. Wide protoconch, off-white to light grey color. Columella slightly bend with four thick continuous plications, which take up half the length of the aperture, off-white color. Aperture wide and slightly bend, off-white color. Background of the body whorl off-white to creamy colored, with brown speckled pattern presented in thin bands around the body whorl. The thin speckled lines become lighter colored presented as a wide band below the shoulder and around the middle, followed by a slightly darker band towards the anterior side. The shoulder has a darker speckled band presented, flowing over onto the spire.

Distribution. Type locality of *M. (N.) muratovi* n. sp. is dredged 74 m off Mncwasa Point (approx. 12 km south-west of Coffee Bay), Eastern Cape, South Africa. All specimens studied occur in deep water ranging from 74-165 m depth.

Type material. The type material of the holotype and paratypes of *M. (N.) muratovi* are as follows:

- Holotype: 19.79 x 10.50 mm (Figure 5.1); off Mncwasa Point (32°05.12'S & 29°06.15'E), dredged 74 m, 1982; Coll. Natal Museum South Africa (NMSA), ID No: C2246/T4435.
- Paratype 1: 21.96 x 11.67 mm (Figure 5.2); off Mncwasa Point (32°05.12'S & 29°06.15'E), dredged 74 m, 1982; Coll. NMSA: C2758/T4436.
- Paratype 2: 20.55 x 9.86 mm (Figure 5.3); off Mgazi (Mngazi River) (31°43.05'S & 29°31.05'E), dredged 92 m, 1982; Coll. NMSA: C2344.
- Paratype 3: 17.70 x 8.04 mm; off Whale Head (32°01.12'S & 29°18.03'E), dredged 150-165 m, 1982; Coll. NMSA: P1500/T4437.
- Paratype 4: 18.31 x 9.53 mm; off Whale Head (32°01.12'S & 29°18.03'E), dredged 150-165 m, 1982; Coll. NMSA: P1501/T4462.
- Paratype 5: 20.12 x 10.00 mm; off Whale Rock (31°58.8'S & 29°16.8'E), dredged 90 m, 1985; Coll. NMSA: C9464/T4438.

Etymology. *Marginella (N.) muratovi* n. sp. is named for Igor Muratov from the Natal Museum, Pietermaritzburg, South Africa, for all his assistance in the past, especially with photographs of type material.

Discussion. *Marginella (N.) muratovi* n. sp. can be compared to *M. (N.) xoraensis* Aiken, 2019 (Figures 5.6 & 5.7) and *M. (N.) thos* S.G. Veldsman, 2013 (Figures 5.4 & 5.5) with general shape. *Marginella (N.) muratovi* n. sp. is similar to *M. (N.) thos* in size, and on average

larger than *M. (N.) xoraensis*. *Marginella (N.) xoraensis* also occur within the Eastern Cape and probably in the same habitat; *M. (N.) xoraensis* is dredged off Xora, approx. 12 km south-west of Mncwasa River. *Marginella (N.) muratovi* n. sp. has a broader and sharper edged shoulder than *M. (N.) xoraensis*, its aperture is wider and slightly more bent, and the body whorl coloration is very different. *Marginella (N.) xoraensis* is a light pale creamy colored shell scattered with dark markings. *Marginella (N.) thos* is slightly narrower than *M. (N.) muratovi* n. sp. and has a narrower slightly more bent aperture. Although the color pattern of the last two mentioned species, are very similar, slight differences between them can be observed. Further, *M. (N.) thos* occur in southern KwaZulu-Natal, at least 70 km north-east of *M. (N.) muratovi* n. sp. with Pondoland separating them, and none of the three species discussed here occur there.

Marginella (Punctamarginella) transovula

S.G. Veldsman, n. sp.

(Figures 6.1, 6.2 & 6.3)

Description. The shell is small (17-22 mm), ovate biconical shaped, has a rounded shoulder; has a thick labrum, smooth and off-white background color with no visible markings, strongly developed posterior notch and labial denticles. Callus is highly developed on the columella. Spire low, very wide and blunt, spire whorls very convex and stepped. Wide protoconch, off-white to light grey color. Columella straight with four thick continuous plications, which take up half the length of the aperture, off-white color. Aperture narrow and straight, off-white color. Background of the body whorl off-white to light creamy colored, with grey to brown finely speckled pattern presented in thin bands around the body whorl. The shoulder grey to brown finely speckled pattern, flowing over onto the spire.

Distribution. Type locality of *M. (P.) transovula* n. sp. is dredged 380-400 m off Sandy Point (across Wavecrest, approx. 16 km north-east of the Great Kei River), Eastern Cape, South Africa. All specimens studied occur in deep water ranging from 380-550 m depth.

Type material. The type material of the holotype and paratypes of *M. (P.) transovula* are as follows:

Holotype: 12.26 x 6.84 mm (Figure 6.1); off Sandy Point (32°41.9'S & 28°42.1'E), dredged 380-400 m, 1984; Coll. Natal Museum South Africa (NMSA), ID No: C7007/T4458.

Paratype 1: 13.56 x 7.67 mm (Figure 6.2); off Nthlonyane (approx. 7 km north-east of Mbashe River (32°18.2'S & 29°06.2'E), dredged 550 m, 1985; Coll. NMSA: C8664/T4459.

Paratype 2: 13.60 x 8.16 mm; off Nthlonyane (approx. 7 km north-east of Mbashe River (32°18.2'S & 29°06.2'E), dredged 550 m, 1985; Coll. NMSA: P1690/T4460.

Paratype 3: 12.71 x 7.49 mm (Figure 6.3); off Rame Head (31°56.02'S & 29°18.03'E), dredged 150-165 m, 1982; Coll. NMSA: C1878/T4461.

Etymology. The name *Marginella (P.) transovula* n. sp. is combined as follows: “trans” related to the name Transkei, what the larger area here was called in the past, and “ovula” for its oval shape.

Discussion. *Marginella (P.) transovula* n. sp. concur with regards to general shell morphological features to most of the species within the subgenus *Punctamarginella*. This species however is slightly different in general

shape, coloration and size to all the other species. The coloration compares slightly to *M. (P.) verdascai* Hayes & Rosado, 2007 (Figures 6.4 & 6.5). Its closest relatives are probably *M. (P.) leoi* S.G. Veldsman, 2013 (Figure 6.7) and *M. (P.) palleukos* Aiken, 2014 (Figure 6.6), but is slightly larger, has a broader protoconch and prominent coloration differences visible. One major point is biogeographical that separates this species from the rest, with all the other species occurring in KwaZulu-Natal with Pondoland separating them, and none of the species in this subgenus occur there. There is at least a stretch of 170 km coast between this species and the rest. This new species is the first in this subgenus to date that is identified to occur in the Eastern Cape, a new distribution for this subgenus.

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Figure 2. 1 = *M. (N.) mbasheensis* (10.95 x 5.97 mm) – Holotype; off Mbashe River, dredged 295-350 m; Coll. NMSA (P1477/T4439). 2 = *M. (N.) mbasheensis* (10.48 x 6.09 mm) – Paratype 1; off Mbashe River, dredged 295-350 m; Coll. NMSA (P1478/T4440). 3 = *M. (N.) mbasheensis* (11.39 x 5.87 mm) – Paratype 2; off Bulungulu River, approx. 22 km south-west of Coffee Bay, dredged 300-370 m; Coll. NMSA (C8548/T4441). 4 = *M. (N.) natalcinerea* (16.21 x 8.14 mm); off Durban, Tugela Bank, trawled; Veldsman Collection. 5 = *M. (N.) mbasheensis* (11.11 x 5.95 mm) – Paratype 3; off Nqabara Point, approx. 44 km south-west of Coffee Bay, dredged 330-340 m; Coll. NMSA (C6445/T4443). 6 = *M. (N.) mbasheensis* (11.76 x 6.31 mm) – Paratype 4; off Shixini Point, approx. 35 km north-east of the Great Kei River, dredged 240 m; Coll. NMSA (C6332/T4443). 7 = *M. (N.) mbasheensis* (11.76 x 6.31 mm) – Paratype 6; off Shixini Point, approx. 35 km north-east of the Great Kei River, dredged 240 m; NMSA (P1480/T4445).

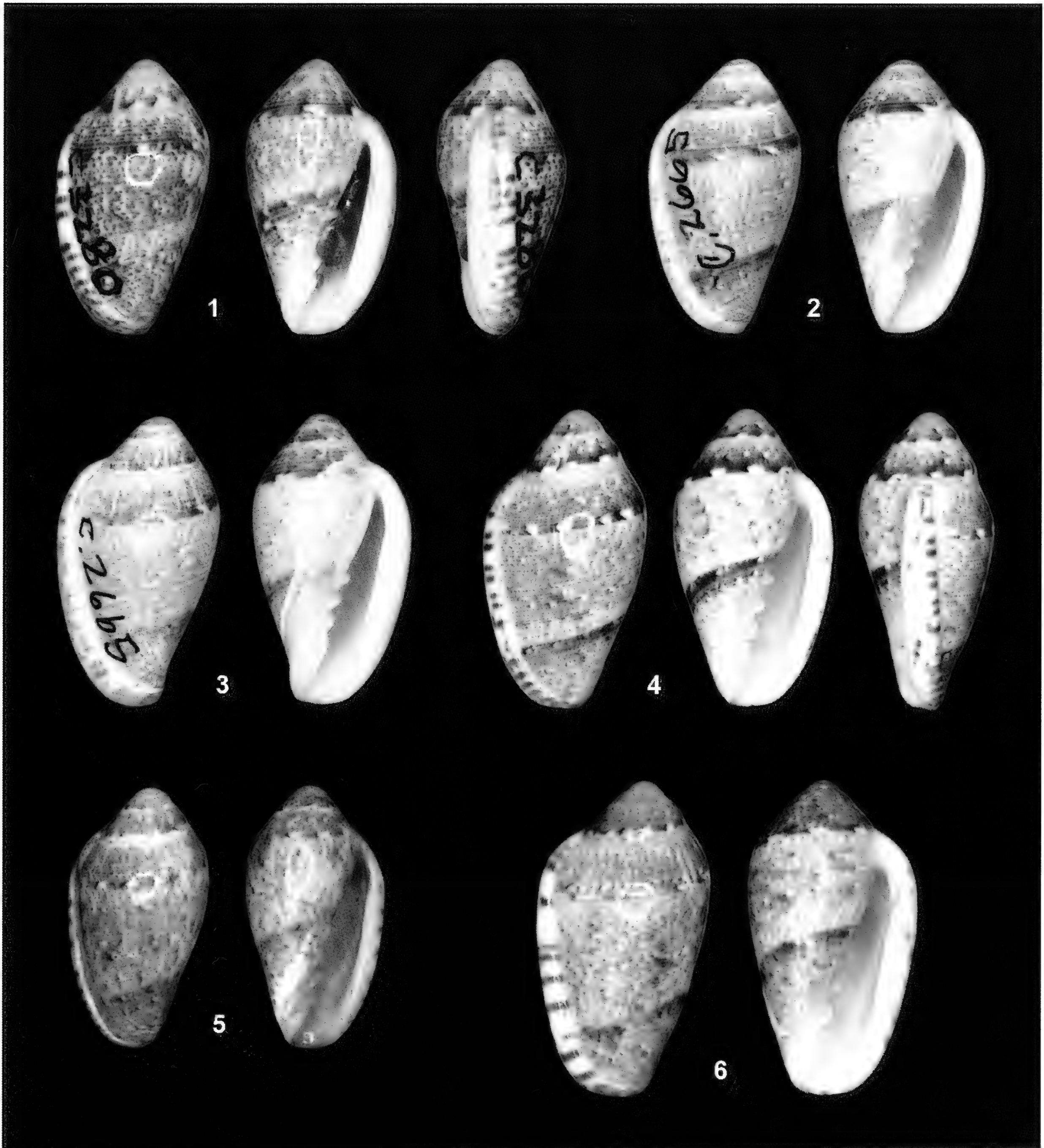


Figure 3. 1 = *M. (N.) mtataensis* (10.68 x 5.82 mm) – Holotype; off Ubombo, dredged 135-165 m; Coll. NMSA (C3280/T4454). 2 = *M. (N.) mtataensis* (10.62 x 5.76 mm) – Paratype 1; off Nthlonyane, approx. 7 km north-east of Mbashe River, approx. 30 km south-west of Coffee Bay, dredged 130 m; Coll. NMSA (P1485/T4455). 3 = *M. (N.) mtataensis* (11.24 x 6.15 mm) – Paratype 2; off Nthlonyane, approx. 7 km north-east of Mbashe River, approx. 30 km south-west of Coffee Bay, dredged 130 m; Coll. NMSA (P1486/T4456). 4 = *M. (N.) wallaceorum* (11.53 x 6.19 mm) – Holotype; off Port Edward, KZN, dredged 125 m; Coll. NMSA (W9482/T3159). 5 = *M. (N.) wallaceorum* (10.81 x 5.91 mm); off Pumula, KZN, dredged 100 m; Veldsman Collection. 6 = *M. (N.) parkrynieensis* (12.21 x 6.65 mm); off Ramsgate, KZN, dredged 95-100 m; Veldsman Collection.



Figure 4. 1 = *M. (N.) mlambomkuluensis* (14.33 x 7.12 mm) – Holotype; off Mbotyi, dredged 200 m; Coll. NMSA (C9750/T4451). 2 = *M. (N.) mlambomkuluensis* (13.76 x 6.96 mm) – Paratype 1; off Waterfall Bluff, dredged 230-250 m; Coll. NMSA (C9857/T4452). 3 = *M. (N.) mlambomkuluensis* (13.68 x 6.69 mm) – Paratype 2; off Whale Rock, dredged 250-280 m; Coll. NMSA (P1484/T4453). 4 = *M. (N.) gracilenta* (15.70 x 7.50 mm) – Holotype; off Pumula, KZN, dredged 100 m; Coll. NMSA (P0326/T4031). 5 = *M. (N.) gracilenta* (14.53 x 6.68 mm) – Paratype 1; off Pumula, KZN, dredged 100 m; Veldsman Collection. 6 = *M. (N.) parkrynieensis* (11.67 x 6.17 mm); off Pumula, KZN, dredged 100 m; Veldsman Collection. 7 = *M. (N.) gracilenta* (13.99 x 6.71 mm) – Paratype 3; off Shelly Beach, KZN, dredged 100 m; Veldsman Collection.

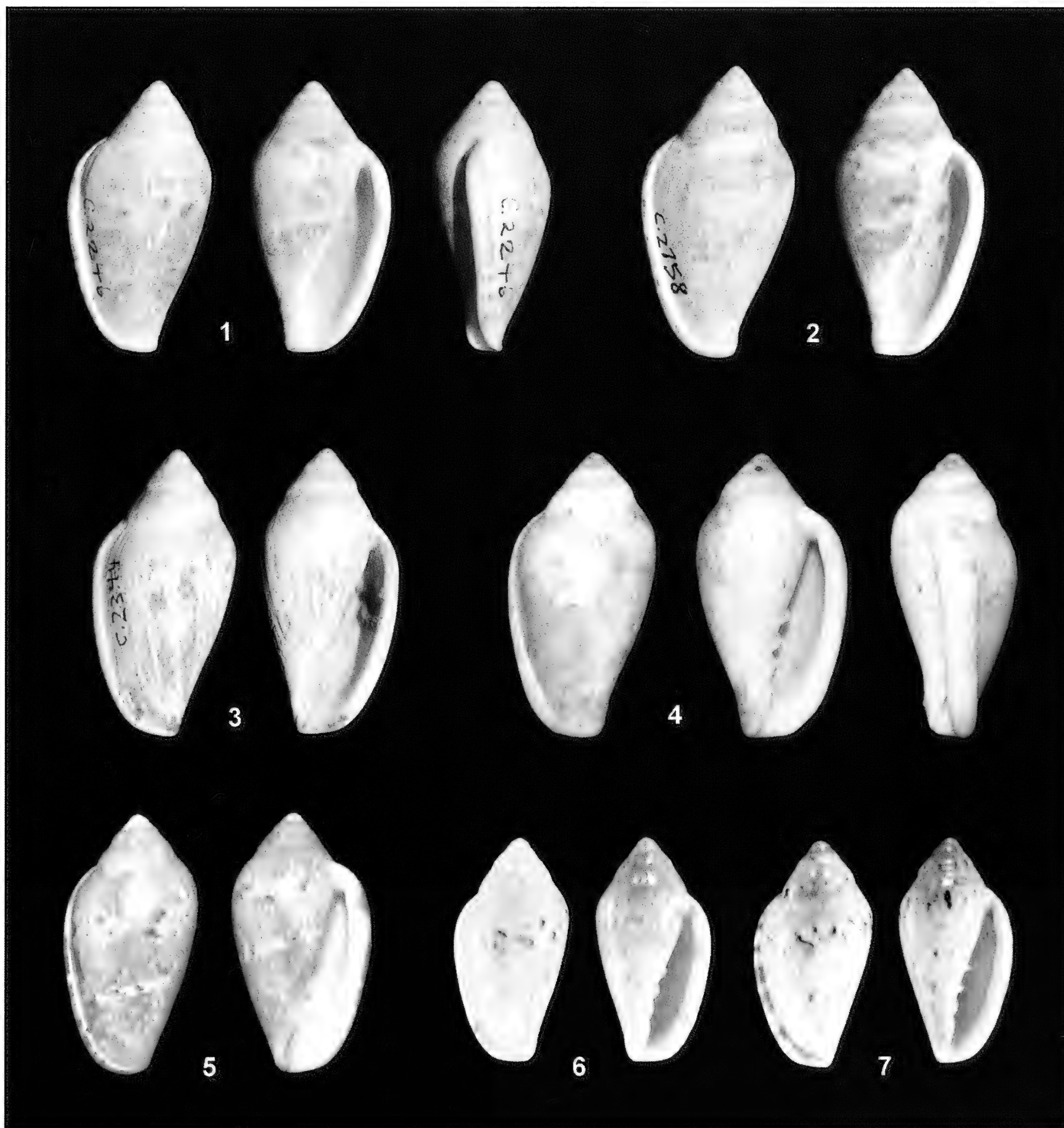


Figure 5. 1 = *M. (N.) muratovi* (19.79 x 10.50 mm) – Holotype; off Mncwasa Point, dredged 74 m; Coll. NMSA (C2246/T4435). 2 = *M. (N.) muratovi* (21.96 x 11.67 mm) – Paratype 1; off Mncwasa Point, dredged 74 m; Coll. NMSA (C2758/T4436). 3 = *M. (N.) muratovi* (20.55 x 9.86 mm) – Paratype 2; off Mgazi (Mngazi River), dredged 92 m; Coll. NMSA (C2344). 4 = *M. (N.) thos* (21.63 x 11.53 mm) – Holotype; off Hibberdene, KZN, dredged 100 m; Coll. NMSA (W9318/T3142). 5 = *M. (N.) thos* (19.05 x 10.61 mm) – Paratype 2; off Hibberdene, KZN, dredged 100 m; Veldsman Collection. 6 = *M. (N.) xoraensis* (15.90 x 7.10 mm) – Holotype; off Xora, dredged 60-80 m; Coll. NMSA (P1137/T4309); photo acknowledged: R. Aiken and M. Page. 7 = *M. (N.) xoraensis* (16.60 x 8.90 mm) – Paratype 1; off Xora, dredged 60-80 m; R. Aiken Collection; photo acknowledged: R. Aiken and M. Page.



Figure 6. 1 = *M. (P.) transovula* (12.26 x 6.84 mm) – Holotype; off Sandy Point, dredged 380-400 m; Coll. NMSA (C7007/T4458). 2 = *M. (P.) transovula* (13.56 x 7.67 mm) – Paratype 1; off Nthlonyane (approx. 7 km north-east of Mbashe River, dredged 550 m; Coll. NMSA (C8664/T4459). 3 = *M. (P.) transovula* (12.71 x 7.49 mm) – Paratype 3; off Rame Head, dredged 150-165 m; Coll. NMSA (C1878/T4461). 4 = *M. (P.) verdascai* (6.66 x 4.17 mm) – Holotype; between Inhaca Island and Ponto do Ouro, Mozambique, dredged 125-145 m; Coll. NMSA (L7354/T2188). 5 = *M. (P.) verdascai* (6.06 x 4.10 mm) – Paratype; between Inhaca Island and Ponto do Ouro, Mozambique, dredged 125-145 m; Coll. NMSA (L7355/T2189). 6 = *M. (P.) palleukos* (10.70 x 5.90 mm) – Holotype; southern KwaZulu-Natal, dredged 135 m; Coll. NMSA (W9651/T3345). 7 = *M. (P.) leoi* (8.73 x 5.35 mm) – Holotype; 2.2 km north of Shelly Beach, KZN, beach collected; Coll. NMSA (W9115/T3001).

A new species of *Amphidromus* from Vietnam (Gastropoda: Camaenidae)

Nguyen Ngoc Thach

199 Thong Nhat Str., Nha Trang, Vietnam

thachshells267@yahoo.com

ABSTRACT A new species of the genus *Amphidromus* from Vietnam is described. It is compared to *Amphidromus frausena* Thach & F. Huber, 2017 of Vietnam and *Amphidromus thachorum* F. Huber, 2020 of Laos having the same chocolate color of columella and outer lip.

KEYWORDS Mollusca, Gastropoda, Camaenidae, *Amphidromus*, Vietnam, Gia Lai, Phú Thiện, Laos, *Cyclotus*, *Ariophanta*, *Dyakia*

INTRODUCTION

The genus *Amphidromus* is a main genus of the family Camaenidae with many of the species collected in Vietnam. While a large number of the species of this genus have been described, our team identified a new species of this genus on a mountain plateau of Central Vietnam that is not listed in the works of Pilsbry (1900), Laidlaw & Solem (1961), Zilch (1964), Solem (1965), Sprinsteen & Leobrera (1986), Parkinson *et al.* (1987), Abbott (1989), Dharma (2005), Sutcharit & Panha (2005, 2006a, 2006b), Severns (2011), Chan & Tan (2010), Stanisic *et al.* (2010, 2017), Sutcharit *et al.* (2015), Stark (2017), Inkhavilay *et al.* (2017, 2019) or Thach (2005, 2007, 2012, 2016, 2017, 2018, 2020). It is hereunder described as new to science.

Abbreviations

DB = David Berschauer Collection
 MNHN = National Museum of Natural History, Paris, France
 PA = Pham Anh collection
 n.sp. = new species

SYSTEMATICS

Class Gastropoda Cuvier, 1797

Subclass Heterobranchia

Order Stylommatophora

Superfamily Helicoidea

Family Camaenidae Pilsbry, 1895

Genus *Amphidromus* Albers, 1850

Type species: *Helix perversus* Linnaeus, 1758
 (subsequent designation)

Amphidromus davidberschaueri Thach,
 new species
 (Figures 1-6)

Description. Shell medium-sized (measuring in average height between 34.5 mm and 38.3 mm) and elongate-ovate with both sinistral and dextral coilings (2/3 collected specimens are sinistral). Shell width 50% of height (see Table 1). Spire moderately tall, apical whorls swollen and red-brown. Body whorl inflated and occupying 65.3% of shell height, periphery rounded. Outer surface ornamented with white spiral bands that are intermittent on spire whorls and continuous but very faint at body whorl. Sculpture consists of broad, white subsutural bands and oblique axial riblets. Aperture elongate and occupying 48.3% of shell height, outer lip moderately thick, regularly convex and slightly reflected, sometimes with white inner margin. Columella curved and inflated, umbilicus widely open. Background chocolate-

colored with black apex, darker outer lip and columella. The type material was provided by Pham Anh from Vietnam.

No./Dimension	1	2	3
SH (mm)	37.0	38.3	34.5
SW (mm)	18.5	19.5	16.8
SW/SH	0.50	0.51	0.49
Mean SW/SH	0.500		
BH (mm)	23.2	25.0	23.5
BH/SH	0.63	0.65	0.68
Mean BH/SH	0.653		
AH (mm)	17.0	18.3	17.7
AH/SH	0.46	0.48	0.51
Mean AH/SH	0.483		

Table 1. *Amphidromus davidberschaueri* type material dimensions: SH=shell height; SW=shell width; BH=body whorl height; and AH= aperture height.

Type material. Holotype (37.0 mm high x 18.5 mm wide) deposited in MNHN with Registration No: MNHN-IM-2000-36535.

Other material. Paratype 1 (38.3 mm high) in DB collection; Paratype 2 (34.5 mm high) in PA collection. All types from the type locality.

Type locality. Phú Thiện District, Gia Lai Province, Central Vietnam.

Diagnosis. The new species is characterized by chocolate color, white spiral bands and red-brown apical whorls.

Habitat. Tree dweller.

Etymology. The new species is named in honor of David Berschauer from USA for his contribution to the development of malacology.

DISCUSSION

The new species is close to *Amphidromus fraussenae* Thach & F. Huber, 2017 (Figure 7), but the color of outer lip and columella is slightly different, spire broader and not pointed, apex not red, parietal wall not well-defined, white spiral bands are present mainly at sutures and outer lip not ascending steeply before touching the remaining shell. *Amphidromus thachorum* F. Huber, 2020 (Figure 8) is distinguished mainly from the new species by more elongate aperture, stronger axial ribs, more inflated columella, not black apex, well-defined parietal wall and presence of black varix.

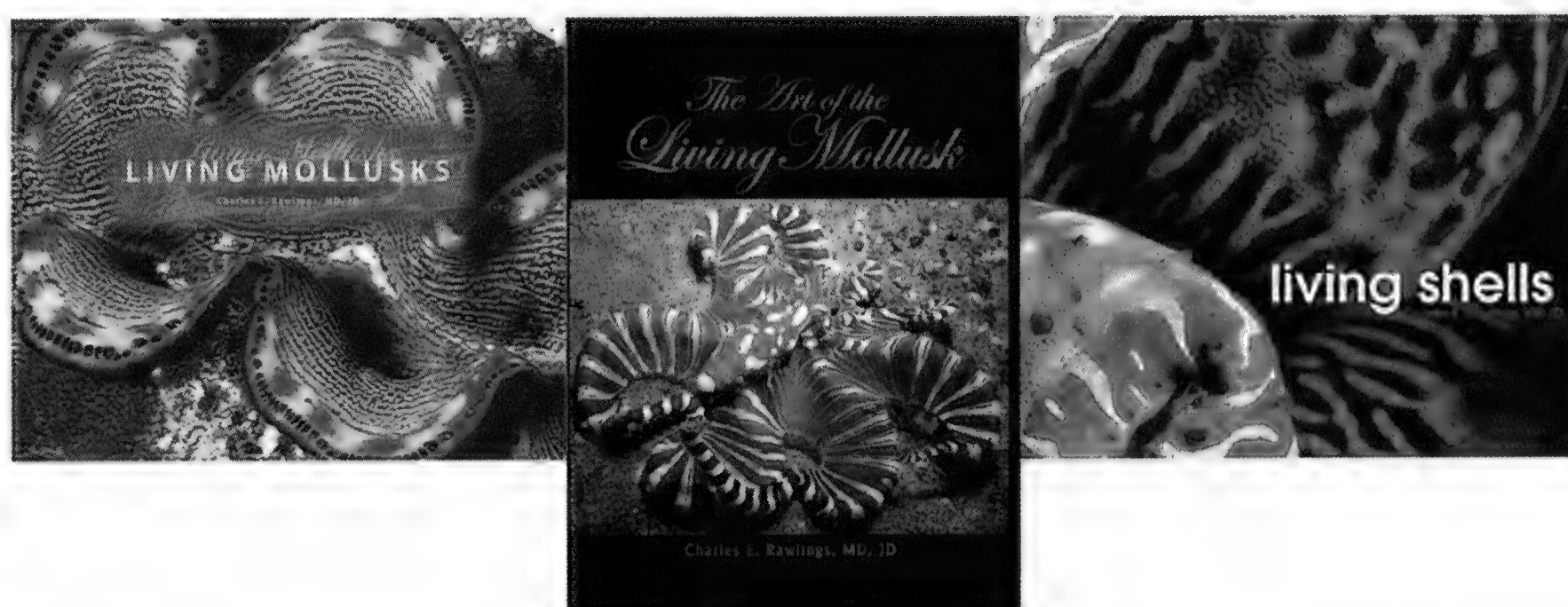
ACKNOWLEDGEMENTS

The author thanks the anonymous reviewers for their work on this article.

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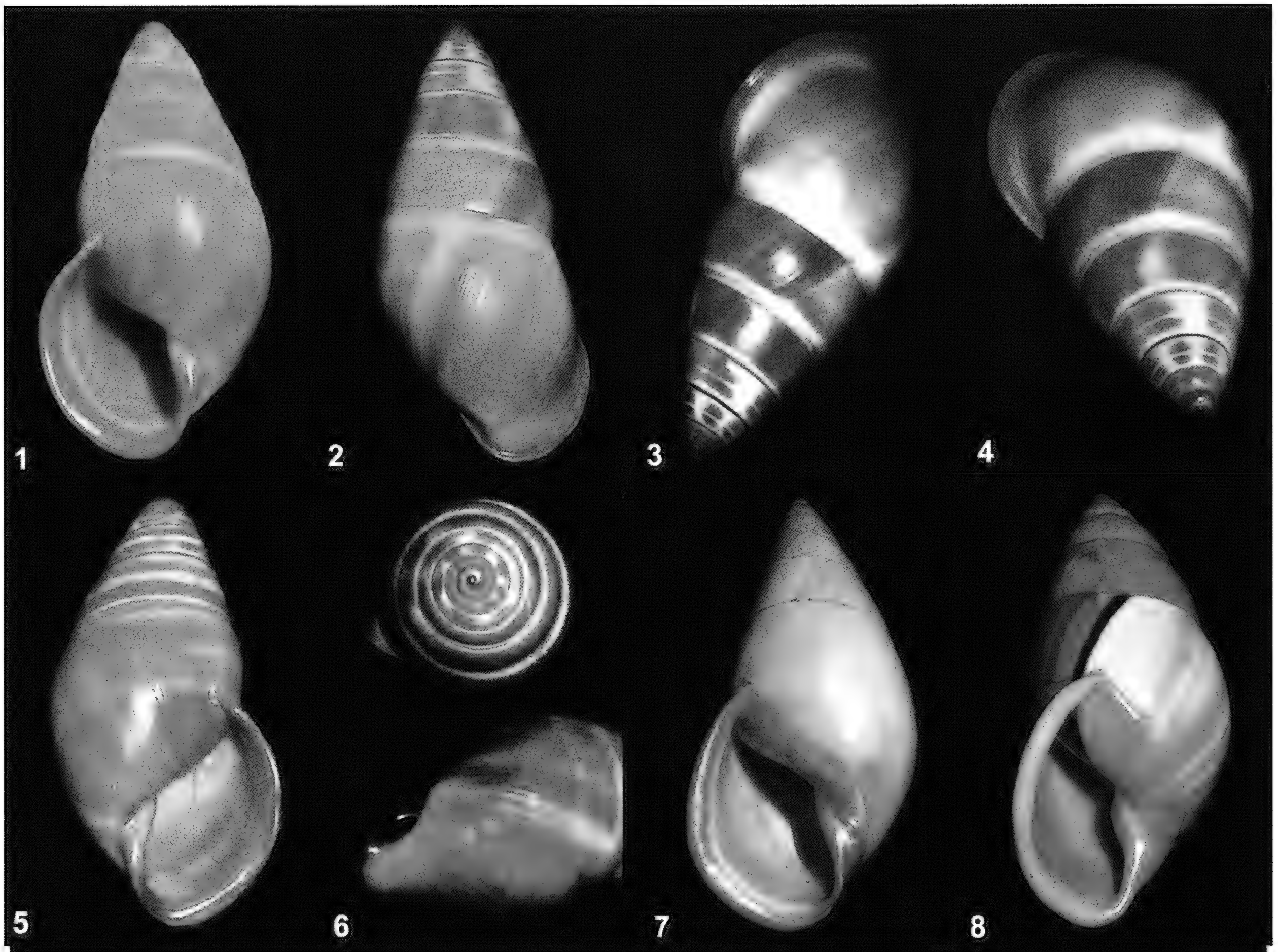
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Figures 1-6. *Amphidromus davidberschaueri* n.sp., Vietnam: 1-2 = holotype 37 mm high with ventral and dorsal views (MNHN-IM-2000-36535); 3 = holotype with reflected outer lip; 4 = holotype with spire view; 5 = Paratype 1, 38.3 mm high with ventral view; 6 = Enlarged apex (top) and umbilicus (bottom) of holotype; 7 = *Amphidromus fraussenae* Vietnam for comparison; 8 = *Amphidromus thachorum* Laos for comparison.



Have a shell collection you would like to donate to The San Diego Shell Club?

The San Diego Shell Club is interested in your shell collection. As a 501c(3) organization, all donations to our Club may provide a tax write-off. When we receive a donation we provide a letter describing the items that may be used when filing your taxes. While we cannot provide a value, donations of up to \$5,000 do not require a written appraisal. Since tax laws change regularly we recommend that you check with your tax accountant before relying on any information provided here.

We are interested in all types of shells, marine or land and all genera and species, including books on shells as well as items related to shells such as artwork, storage cases and tools. Your donated items will be used to generate income to support the Club's efforts in continuing Public education about shells and conservation of marine life throughout the world. If you would like to donate, please contact David Waller, SDSC Acquisition Chairperson, at dwaller@dbwipmg.com to schedule a time to discuss charitable gifting.

CLUB NEWS

2021 May - General Meeting

On May 15, 2021, past president Roger Clark discussed "Shells of Alaska", a detailed look at the molluscan biodiversity of our northernmost state. Roger included many photographs of the species he discussed, giving the viewers a fascinating glimpse at many rarely-seen mollusks. Here is a link to a video recording of the talk:

https://cccconfer.zoom.us/rec/play/Vpob-XXDZvCtDTBCl7V92ie-U9yjqhngUIyZXK079o8nKs43P_qOgPPUrZp_oK9-4S6hULbR9ODyRefZ.ISttPR0Owsm-pBAA?continueMode=true&xzmrtaid=z3GCaWf0RV6kSdJs7BMLCw.1624493595107.dfb29419c5cae759aa82bf5c61ccce82&xzmrtaid=234

2021 June General Meeting

On June 19, 2021, Dr. Paul Tuskes discussed his study "*Octopus bimaculoides*; Impact of Habitat Complexity and Stability on Diet, Survival and Reproduction", conducted in Mission Bay in San Diego, California. The natural history of our local octopus species' was discussed, enhanced by many underwater photographs taken by Dr. Tuskes of habitat types, octopus dens and octopus behavior, among other things. Here is a link to a video recording of the talk:

https://cccconfer.zoom.us/rec/play/PoAzluXKN3wrq1DHBGfxqH7toLFj_EuK24CSPvqG4kK14rn2VKJ93Awk5xINFhGot4jrtrtQu1MJsEGhr.FDb6uAk2iMb_zFQG?continueMode=true

2021 July - Krattli Collection Legacy Auction

The long-awaited SDSC Auction (originally scheduled for last November but delayed by world events) was held on July 3, 2021 at the home of Larry and Debbie Catarius. The auction was well attended and many shells from the beautiful Krattli Collection found new homes! Club members who had not seen each other for a while got a chance to say hi and catch up, and in general a great time was had by all.

San Diego Shell Club; Streamlining Operations - Part I

David B. Waller, Vice-President

Over the past several years, the SDSC has steadily increased its membership, expanded its on-line presence and now distributes *The Festivus* worldwide. Suffice it to say, we are growing and with that growth we have decided to begin to streamline some of the tasks that we do administratively to make these processes easier to perform. Of course, streamlining does not come without a financial cost, but with our continued growth, it is our hope that these expenses can be offset with membership fees. The two primary areas being streamlined in 2021 will be the publication and distribution of *The Festivus* and revitalizing the Club's website. Part I of this series discusses streamlining the distribution of the Club's publication and Part II will address the modifications to the Club's website.

Since 2014, when the Board of Directors decided to recreate the "look and feel" of the *The Festivus*, the Club's membership has grown from less than 70 members to over 200. Our new publication is now distributed around the world. With the increasing volume of mailings it has become a labor intensive task to distribute hard copies of our publication on a quarterly basis. The Club has recently identified an outside vendor that will receive our journal from the publisher, insert *The Festivus* into a preaddressed envelope that they provide and mail the envelope to our members. There will be an increase in cost (~ 65%) for this streamline approach, but it will assure that distribution is not delayed by a lack of person power.



There are a couple of catches with this process. The first is that members will have to make sure that their annual membership dues are paid in advance, and on time, (e.g., by November of the preceding year) to be included in the roster given to the vendor for the upcoming year. It will be possible to add names throughout the year, but that could cause delays in those members receiving the publication. In addition, the roster will be recreated each year, meaning that all prior members that have not paid before the February publication will be removed from the roster. Consequently a late paying member, after being reinstated, may not receive their February issue until May or possibly later.

The new system will be instituted this year and will be fully operational in 2022. We anticipate that any administrative complications that could arise would be resolved in 2021 so that beginning in 2022 the system will operate smoothly into the future.

The increased cost of streamlining, as well as the increased cost of overseas shipping, has required the Board of Directors to consider options that will offset these increases in the short term. One option being considered is raising membership fees. While the Board would like to keep the membership fees as low as possible, they must also assure that these fees are able to support the Club's annual expenses, of which a large portion is allocated to the Club's journal. Thank you to all of our members for your continued patronage and support.

Seizure and Forfeiture United States Fish and Wildlife Service and The Endangered Species Act of 1973 - Part II

David B. Waller
505 North Willowspring Drive, Encinitas, California 92024
dwaller@dbwipmg.com

In Part I of this three part series, I wrote about a recent confiscation of a parcel containing two shells, *Eugenconus nobilis victor* and *Cypraea mauritia mauritiana*, by the USFWS because the “parcel was found to contain wildlife/plant products imported in violation of U.S. federal law” and seized under the “Endangered Species Act, 16 U.S.C 1538”. I discussed how the powers granted the USFWS to enforce the Endangered Species Act of 1973 were being applied to this case. I discussed that when inspectors act with impunity they can infringe certain rights granted by the United States Constitution to all citizens. This includes protection from illegal searches and seizures, right to privacy and the requirement for probable cause before a search. It seemed clear that one of the crucial problems with the current USFWS process is transparency.

In Part II, I discuss conversations with Inspector Yashuda regarding the USFWS Notice of Seizure and Proposed Forfeiture, preparation of a Petition for Remission, as well as requests submitted to the USPS and USFWS under the Freedom of Information Act, and notification letters to Senators Dianne Feinstein, Alex Padilla and Thomas Carper (Chairperson of the Environment and Public Works Committee, which oversees the USFWS).

So, the question remains as to how the USFWS could have made this error in identifying these two relatively common shells as endangered species? Initially, I was concerned that one of the shells may have recently been listed as endangered without my knowledge. A quick review of the species covered by the Endangered Species Act and those listed by CITES confirmed that there were no Cypraidae or Conidae species listed. With that information, I decided to contact the USFWS Inspector directly to explain the circumstances; letting her know that I am a shell collector and not a dealer and to obtain information on the process for recovering my shells. I presumed that since the shells were neither endangered species covered under the Endangered Species Act nor species listed under CITES, my explanation would be sufficient to allow the USFWS to release the shells. Well that could not have been farther from the truth based on the Inspector’s comments.

In my first telephone conversation with the Inspector, I informed her that I had been collecting sea shells for about 20 years and reviewed all of the endangered species covered under the Endangered Species Act or listed on CITES Appendices I-III and that no species of the families Conidae or Cypraeidae are listed. Consequently, the two shells were not endangered species. In addition, I was not “engaged in business as an importer or exporter of fish or wildlife” (a provision of 16 U.S.C. §1538 that allows the USFWS to enforce their inspection and seizure authority), I was merely a collector or hobbyist (defined under 50 C.F.R. §14.91 (6) as it applies to 16 U.S.C. §1538). Her responses were jaw-dropping. She specifically stated that the species contained in my parcel did not

have to be endangered species for the USFWS to seize and confiscate them. That while they were enforcing powers granted the agency by Congress to enforce the Endangered Species Act; it was not relevant that the items seized are endangered species. She indicated that the USFWS regularly seizes parcels containing wildlife and/or plants as a way to monitor trade in given species and identify potential species that may become endangered. I then asked what I could do to recover my property. She indicated that I could file a Petition for Remission, but that I would likely not be successful. I may have misunderstood some of the information provided by the Inspector, but this was what I understood from our communication and I was understandably floored.

The Inspector's comments spiked concerns on several levels. If parcels seized and confiscated did not have to contain endangered species: (1) Why was I in violation of the Endangered Species Act if my shells were clearly not endangered species?; (2) What authority given the USFWS by Congress under the Endangered Species Act allows seizures and confiscations of non-threatened or endangered species as a method to effectively and efficiently enforce Congress' objective; and (3) Without clear regulations that prevent the USFWS from acting with impunity, how does the Environment and Public Works Committee enforce its oversight authority over the Agency? Of particular concern was the Inspector's comment that the USFWS regularly seizes parcels as a way to monitor and track trade of wildlife species that could become threatened or endangered. So this raised the question of how the USFWS compiles, analyzes and obtains sufficient quantities of samples of a given species, in a given location based on seized parcels and how that research is presented to Congress for future endangered species listings? Simple, it doesn't! The USFWS does not recommend species for listing. They accept petitions from the public, conduct internal reviews of the information provided, solicit expert opinions, seek input from community, state and federal agencies and then make a decision that is published in the Federal Register (see Figure 1). So, why is the USFWS really seizing property? This question becomes more complicated when one considers that the USFWS is permitted, under law (50 C.F.R. §12.37), to sell confiscated items (items not listed as endangered species under the Endangered Species Act) to generate revenue.

So what can someone do, who is merely a collector, when their property is seized by the USFWS? Well, the USFWS is hoping that they will not pursue the complicated process of submitting a Petition for Remission and just walk away. Of course, the USFWS does provide guidelines on how to prepare a Petition for Remission (50 CFR §12.24), but how does the Petitioner know that the information the Agency suggests be included in this document will not implicate him/her in a crime for which the punishment is a fine and/or imprisonment? The fact that they can seize non-endangered species and then sell them to generate revenue does not lead a person to trust the Agency. Consequently, you could seek a lawyer, but in doing so, you have to balance the value of the shells seized with the cost to secure legal assistance in the hopes of recovery. Given this, I estimate that 90% or more of the seizures by the USFWS go unchallenged.

After hearing the confidence in the Inspector's voice that my property would not be returned, I decided to "take the red pill and see how deep the rabbit hole goes" (quote from the movie, Matrix) and shine some light on the Agency's seizure policies. But I needed an overall strategy and not blindly follow the procedures suggested by the Agency. I leaned a little on my legal training and decided to file a Petition for Remission to comply with the USFWS' request as a first step in

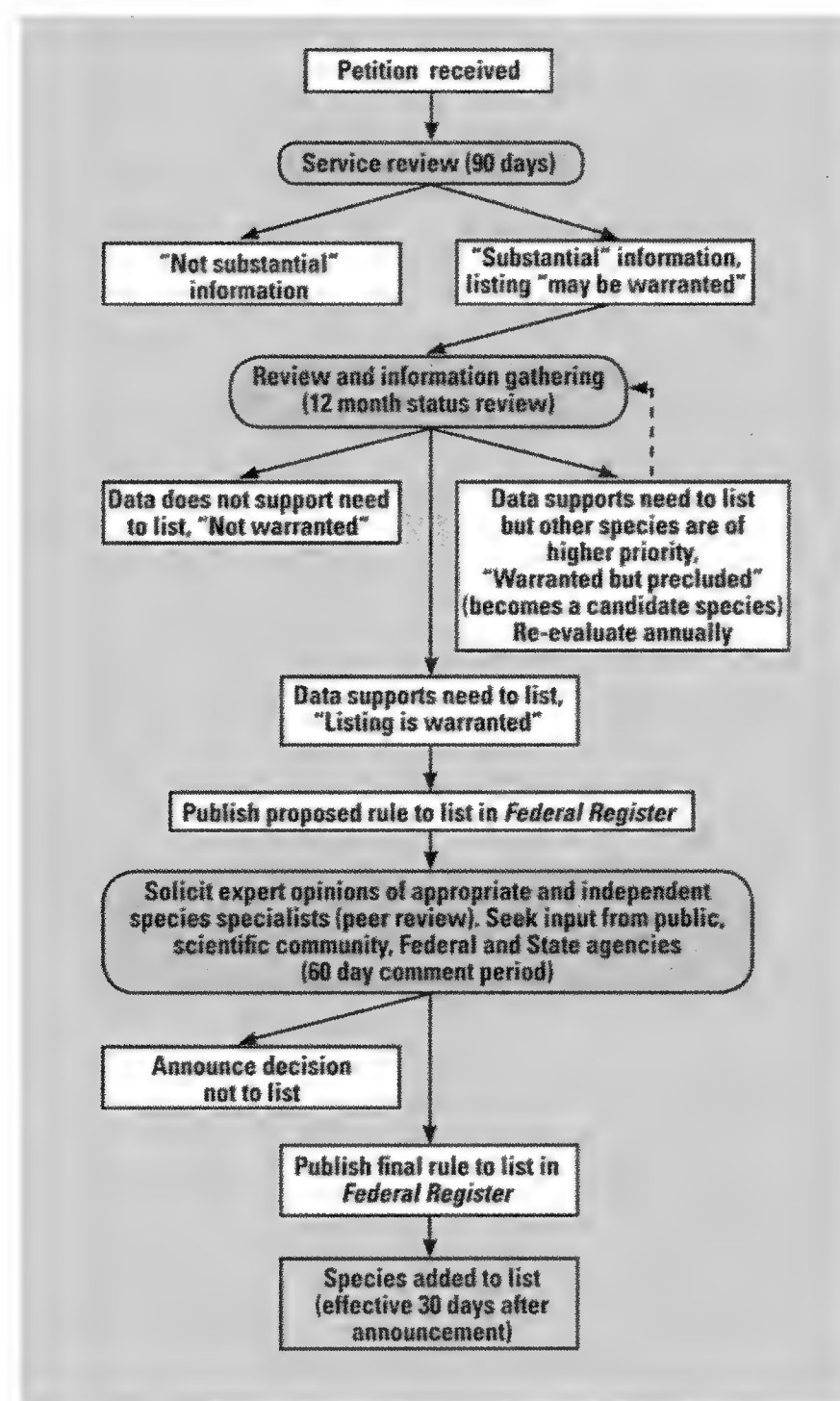


Figure 1. Schematic diagram from the USFWS website showing the process by which a petition to list a species as endangered proceeds to listing.

recovering my property. However, while it would contain the information the Agency requested, I intended to add much more information on the legal issues raised by their actions to create a record. So the petition contained a detailed summary of the events culminating in the seizure (USFWS requirement). Next, it addressed the purported violations of all United States Codes cited by the Agency explaining lack of evidence to support their contentions and how the code sections did not apply in this circumstance (also required by the USFWS). It contained a separate section clearly identifying the seized property as not being endangered species under U.S. law or CITES. I then broke down the legal requirements for searches and seizures using the U.S. Fish and Wildlife Codes to demonstrate lack of probable cause. I noted that there is an absolute expectation of privacy in U.S. mail that is violated when there is no probable cause to open parcels. Next, I addressed interpretation of the law with respect to who is “in the business of importing and exporting wildlife” under the Endangered Species Act and how a misinterpretation, or lack of evidence, violated my 4th Amendment rights. Finally, I addressed the act of confiscation to cover-up illegal acts, retaliation by targeting future parcels, interference with Freedom of Information Act requests to gather information and the potential for the Inspector to have acted outside the scope of her employment. This was the first of a four step process.

After filing the Petition for Remission, I filed FOIA requests with the USFWS and USPS requesting all documentary evidence supporting the Notice of Seizure and Proposed Forfeiture (see Figure 2).

This is a request under the Freedom of Information Act for copies of the following documents promulgated from a Notice of Seizure and Proposed Forfeiture of a parcel:

Addressee: "David B. Waller, 505 North Willowspring Drive 92024 Encinitas, United States"

File No.: INV 2020804616 (herein referred to as "the parcel")

Seizure Date: 1/13/2021

Property: two (2) shells

Value: Ten (10) Dollar(s) (Actual value \$59.82, paid by owner)

USFWS Inspector: Catherine Yashuda

1. Any and all documents received by USFWS and/or Inspector Yashuda from the United States Postal Service, International Sorting Center (USPS ISC), San Francisco Air Mail Center regarding Seizure and Proposed Forfeiture of the parcel.
2. Any and all images (e.g., X-ray images) and photographs received by USFWS and/or Inspector Yashuda from the USPS ISC, San Francisco Air Mail Center regarding Seizure and Proposed Forfeiture of the parcel.
3. Any and all documents supporting the USFWS and/or Inspector Yashuda's "probable cause" for seizing and searching the parcel.
4. Any and all analyses performed and documentation created by the USFWS and/or Inspector Yashuda of the contents of the parcel are CITES listed or endangered species protected under the Endangered Species Act of 1973.
5. Any and all documentation that the USFWS has, or has obtained, that demonstrates or supports the assertion that the Addressee of the parcel is "in the business of importing or exporting wildlife or plants" as it pertains to 16 U.S.C. §1538.
6. Any and all evidence that the USFWS has, or has obtained, that demonstrates or supports the assertion that Addressee has violated 16 USC §1538(d)(1)(A), 16 USC §1538(e), 16 USC §3372(b) and or 16 USC §1540(e)(4)(A) as it pertains to the parcel.
7. Any and all documentation created by the USFWS and/or Inspector Yashuda that provides legal justification for opening Addressee's parcel, seizing its contents and declaring the content forfeit as it pertains to the parcel.

This is a request under the Freedom of Information Act for copies of the following documents promulgated from a Notice of Seizure and Proposed Forfeiture of a parcel:

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Property: two (2) shells

Value: Ten (10) Dollar(s) (Actual value \$59.82, paid by owner)

USFWS Inspector: Catherine Yashuda

1. Any and all documents forwarded to the USFWS and/or Inspector Yashuda regarding USFWS Office of Law Enforcement's Notice of Seizure and Proposed Forfeiture of the parcel, USFWS File Number: INV 2020804616.
2. Any and all images (e.g., X-ray images) and photographs forwarded to the USFWS and/or Inspector Yashuda regarding USFWS Office of Law Enforcement's Notice of Seizure and Proposed Forfeiture of the parcel, USFWS File Number: INV 2020804616.
3. Any and all documents supporting the USPS ISC's "probable cause" for diverting Addressee's parcel to the USFWS, USFWS File Number: INV 2020804616.
4. Any and all analyses and/or documentation created by the USPS ISC San Francisco Air Mail Center of the contents of the parcel, USFWS File Number: INV 2020804616, that justifies the decision to forward the parcel to the USFWS.
5. Any and all maintenance documentation demonstrating any and all equipment used to investigate Addressee's parcel (USFWS File Number: INV 2020804616) was maintained according to the manufacturer's procedure manual and USPS ISC policy and was in good working order when used to screen Addressee's parcel, USFWS File Number: INV 2020804616, before forwarding the parcel to the USFWS.

Figure 2. Freedom of Information Act requests submitted to the USFWS and the USPS.

Following the submissions of the FOIA requests, I submitted letters to our two California State Senators and the Chairman of the Committee that oversees the USFWS (see Figure 3).

Senator Dianne Feinstein
880 Front Street, Suite 4236
San Diego, CA 92101

1 March 2021

RE: USFWS Abuse of Power, USFWS File No. INV 2020804616

Dear Senator Feinstein,

I have been a California resident for over 56 years, own a business (Patent Success Strategies, LLC) and am a licensed patent agent (43,978). I have degrees in Chemistry, Biochemistry and Law. For pleasure, I collect sea shells and am an amateur malacologist serving on the San Diego Shell Club Board of Directors for nine years and Editor of the Club's Journal, *The Festivus* a world recognized journal in the fields of conchology and malacology.

The reason for this letter is to inform you of an abuse of power being exercised, seemingly without oversight, by the USFWS. This agency is currently using their powers established under the Endangered Species Act of 1973 to randomly seize parcels and declare their contents forfeit without proper due process and evidence to legally justify their actions.

Prior to having one of my parcels seized, I was unaware that this is a rampant practice by the USFWS to seize items that are not considered endangered species or CITES listed. Since this event, I have received many accounts from our San Diego Shell Club members regarding this practice that are similar to mine. As a shell collector, Vice President of the San Diego Shell Club, Editor of *The Festivus*, resident of the great state of California and United States citizen I am requesting that this seizure be investigated, not specifically for the return of my personal property, but to better understand the procedures currently used by the USFWS to enforce the Endangered Species Act, to assure the level of knowledge of the Inspectors is adequate to perform their duties properly, and to review and/or establish appropriate oversight by Congress to prevent future abuses of power by this agency.

Thank you for your time and your service to our state and our country. Please do not let the events of January 6th or the past four years deter you from the good work that you do for all of us. You and your colleagues are true heroines and heroes.

Sincerely,

David B. Waller, M.S., J.D.

Attachments: Copy of an article from *The Festivus*
Copy of Petition for Remission
Copy USFWS Communications

Figure 3. Letter sent to Senator Feinstein.

Finally, depending on the responses obtained from the USPS and USFWS FOIA Requests and the Senators, I would prepare a letter notifying the USFWS and Inspector Yashuda of potential claims against the Agency and/or the Inspector. After executing three of the four steps of my process, I received a call from the Inspector letting me know that they received the Petition for Remission. She stated that a Declaration (Form-3-177) was still required and that if I needed assistance in completing the form that she would help. She also indicated that my shells would likely be returned. I completed the form with the Inspector's assistance and submitted it that day.

Shortly after filing the declaration, I received a letter from the USFWS declining my FOIA request. They claimed that their refusal is permitted under 5 U.S.C. §552(b)(7)(a), which allows the Agency to decline production of documents if it "could reasonably be expected to interfere with enforcement proceedings." Really? So any person can be accused by the USFWS of multiple violations of the Endangered Species Act without the Agency providing any supporting evidence, and when the accused requests information that formed the basis of the Agency's allegations, the Agency can refuse based on the exception that there is an ongoing investigation. How interesting! The refusal does allow the requester to appeal. This process requires, among other things, that the Appellant describe the "error" made by the USFWS in refusing to respond to the FOIA request and must contain "all" communications with the Appellant from the USFWS regarding the issue that resulted in the FOIA request. If this information is not provided to the Solicitor, then the Appeal can be refused. This seems strange when you consider that most, if not all, of the documentation being requested was generated within the Agency. Consequently, they have complete access to all of the communications being requested. So, this requirement seems like an attempt to provide a convenient way for the Solicitor to obviate the appeal process as opposed to assuring that all of the appropriate information is contained in the Appeal.

Several days after submitting the FOIA Request Appeal it was denied with the Solicitor restating exemption (7)(A) as the reason for the denial. What is interesting is that this denial comes after I received notification that my Petition for Remission was accepted and the shells had been returned. These facts, demonstrate the lack of an "ongoing investigation" for which exemption (7)(A) would apply. Consequently, a second appeal was filed.

Once again, the crucial problem with the Agency's current process seems to be transparency. Claims made by the USFWS should be fully supported with clear and convincing evidence and that evidence should be provided to the accused, without the need to file a FOIA request. The intent of the Freedom of Information Act was eloquently stated in *McGehee v. CIA*, 697 F.2d 1095 (D.C. Cir. 1983). The Court of Appeal in that case found that "It has often been observed that the central purpose of the FOIA is to 'open ... up the workings of government to public scrutiny.' One of the premises of that objective is the belief that 'an informed electorate is vital to the proper operation of a democracy.' A more specific goal implicit in the foregoing principles is to give citizens access to the information on the basis of which government agencies make their decisions, thereby equipping the populace to evaluate and criticize those decisions." It appears that the USFWS, like the CIA in that case, have a different view of the purpose for the Freedom of Information Act; this is a problem that needs to be addressed by Congress.

Western Society of Malacologists 54 Annual Meeting - Summary

Paul N. Tuskes
tuskes@aol.com

The Western Society of Malacologists (WSM) was held as a virtual meeting, and organized by Dr. Miguel Angel del Rio-Portilla and his group at CNSANDA in Ensenada, Baja California, Mexico. Registration and the WSM business meeting on held on 28-29 June and presentations were given from 30 June to 2 July. The abstracts from the meeting are published in both Spanish and English. The papers and posters represent the research of approximately 140 biologists with a wide range of specialties. The number and scope of the presentations make it impossible to adequately summarize each section.

Symposium topics included the following:

Biodiversity. Thirteen papers were presented that included a wide range of topics, from Heterobranchs biology and diversity, abalone monitoring programs, octopi biology, parasitic gastropods, invasive land snails, and reviews of two new books; Baja California Field Guide to Sea Shells and Bivalves of Peru and Chile.

Current status of mollusks diseases in the West Coast of North America. Fourteen papers addressed diseases of abalone and bivalves in the Californias were presented. Identification of the pathogens, pathology, and environmental conditions that contribute to their on-set were discussed. Genetic analysis of eastern Pacific abalone has better defined their relationships, with some groups more susceptible to certain pathogens than others. The bivalve papers focused on the oyster genus *Crassostrea*. Three posters were also presented.

Aquaculture. Three papers focused on the culture of green abalone, *Octopus bimaculoides*, and the bivalve *Crassostrea gigas*. New techniques for supporting various life stages were discussed as were adjustments to diets.

Genetics. Nine papers targeted primarily Octopi and Abalone. Genome sequencing yields valuable information regarding genetic diversity, relationships, and recognizing unique populations that should be addressed in management programs.

Poster Session. Eleven posters addressed a wide range of research including cephalopods, bivalve, impact of the red crab on substrate, microalgae, abalone, physiology.

San Diego Shell Club members presenting papers include: Drs. Hans Bertsch, Doug Eernisse, and Paul Tuskes

Book Review: Marine Molluscs of French Polynesia

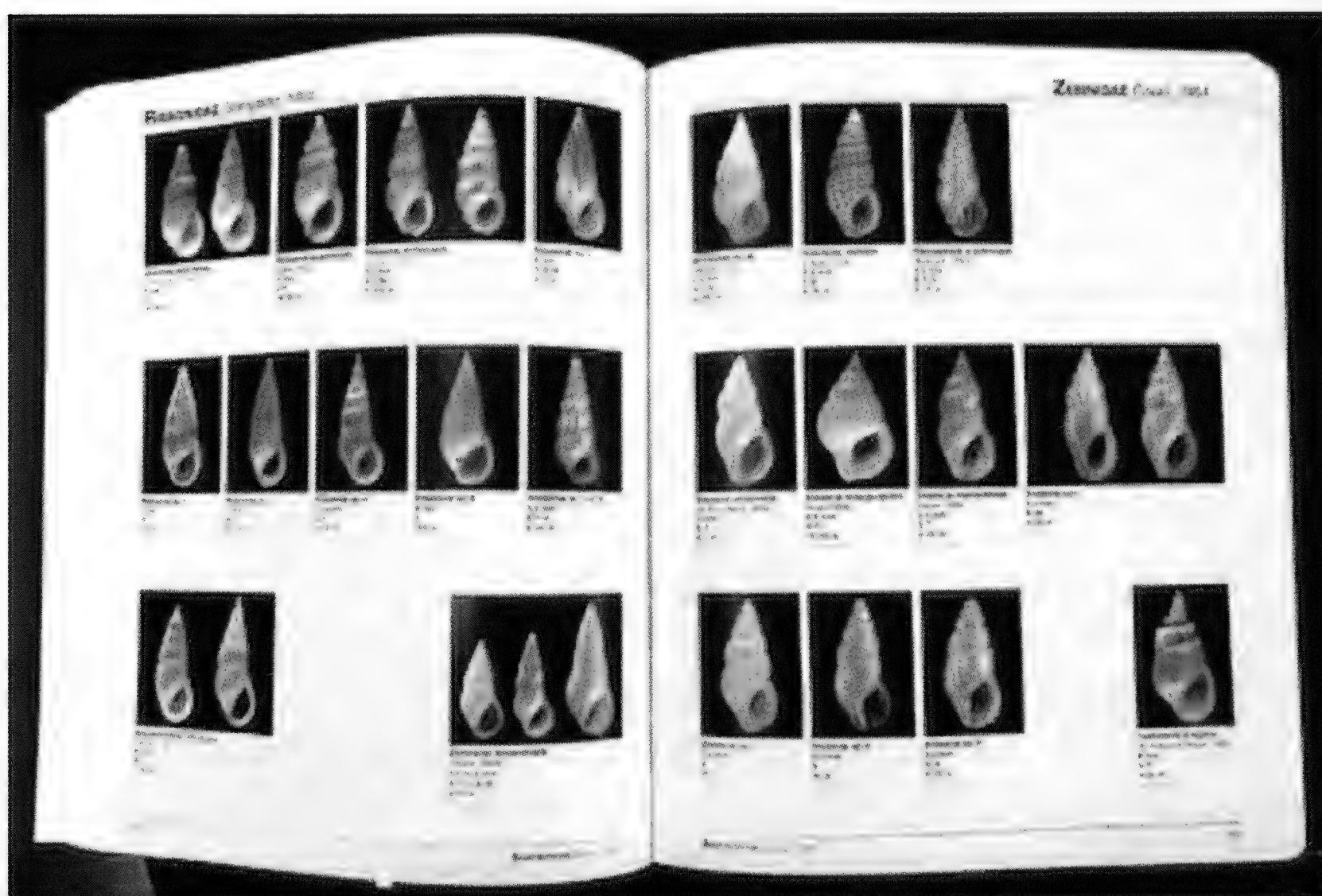
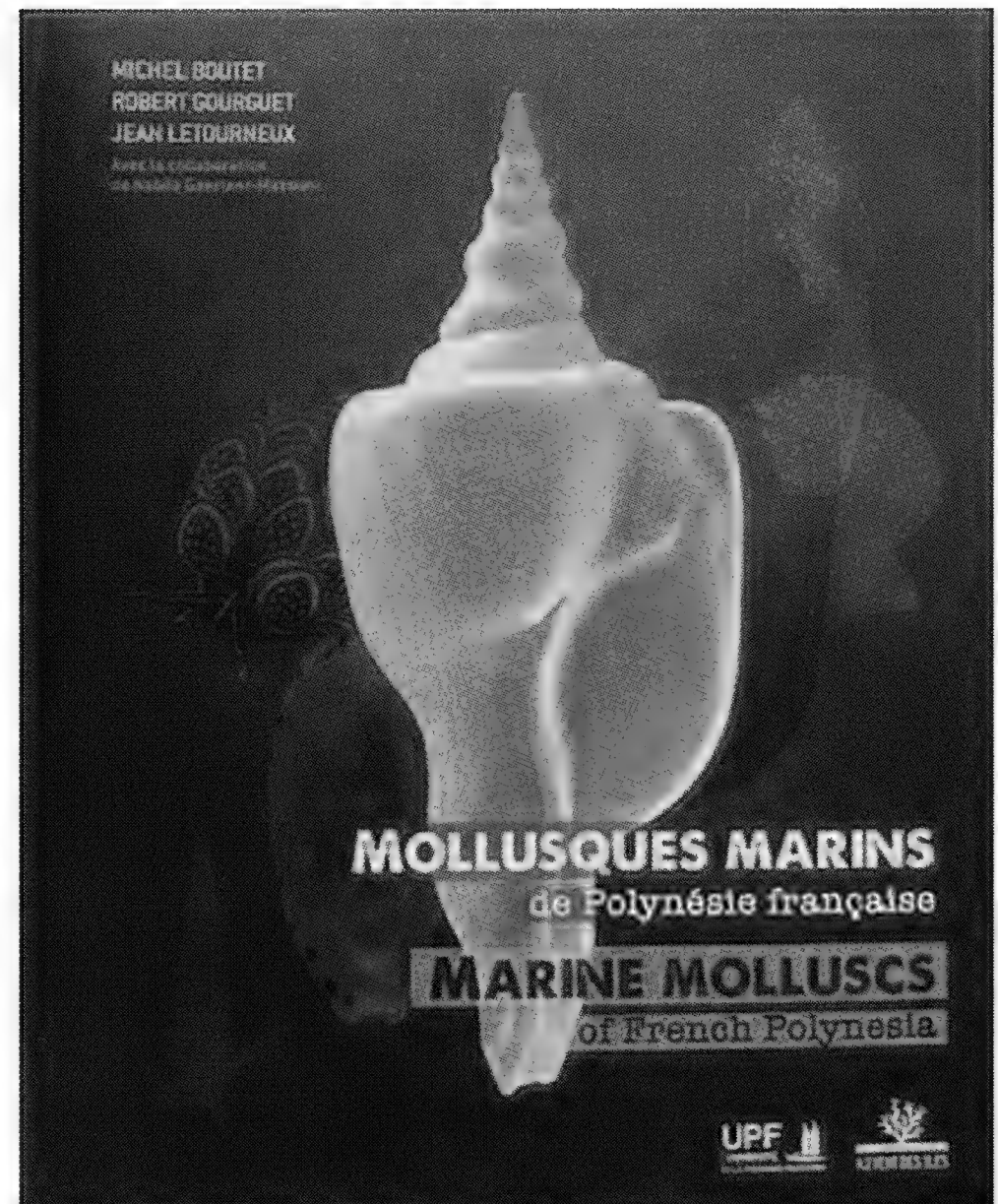
Philippe and Guido Poppe

This year, we are delighted to see – after many years of work for the authors - the long awaited **MOLLUSQUES MARINS DE POLYNÉSIE FRANÇAISE**. The authors are well known by the international community of shellers: Michel Boutet, Robert Gourguet and Jean Letourneux.

Lifting this book “makes muscles,” as it has not less than 766 pages and is printed on luxury high quality paper with high quality printing.

The authors enjoyed the contributions of fourteen other scientists. There is an extensive introduction on all aspects of mollusks and the Archipelago's concerned: geographical aspects, the history of shell exploration, geomorphology of the Islands, the place of shells in the daily life, even some tribal arts items with shells are shown, amongst these a full page with the famous Tahitian costume of the "deuilleur" from the British Museum. All these forms already a book on itself. Finally, at plate 88 we move to pure "malacologist" subjects, an outline of the book is given, followed by a systematic listing and finally the "Presentation of the Malacofauna of French Polynesia".

It is important to note that this book is bilingual: FRENCH and ENGLISH. There is a wealth of information on the families and the species shown. The photographs of each species, as can be expected from a French book, are excellent and this is the worthy and long-awaited replacement of the old Salvat & Rives we all used so many years as young collectors. For the deep going malacologists the book is a true delight as many hundreds of micro shells are shown in the greatest detail. We here show one double page that will give you an idea of the tremendous documenting force of the work achieved.



This is only part of the Rissoinidae: few books will give you such a nice overview of this kind of amazing families ... we should say, we live in fantastic times!

There are many more interesting features: a wealth of living animal photographs, for example, you will be able to see photos of living *Naria bernardi* and *Cryptocypraea dillwyni*, and so many others! A fine Index and a good bibliography finish this mammoth work.

We from Conchology, Inc. congratulate heartily the authors and collaborators for this achievement.

My Favorite Shell

Roger N. Clark

3808 Pinehurst Drive, Eagle Mountain, Utah 84005

Insignis_one@yahoo.com

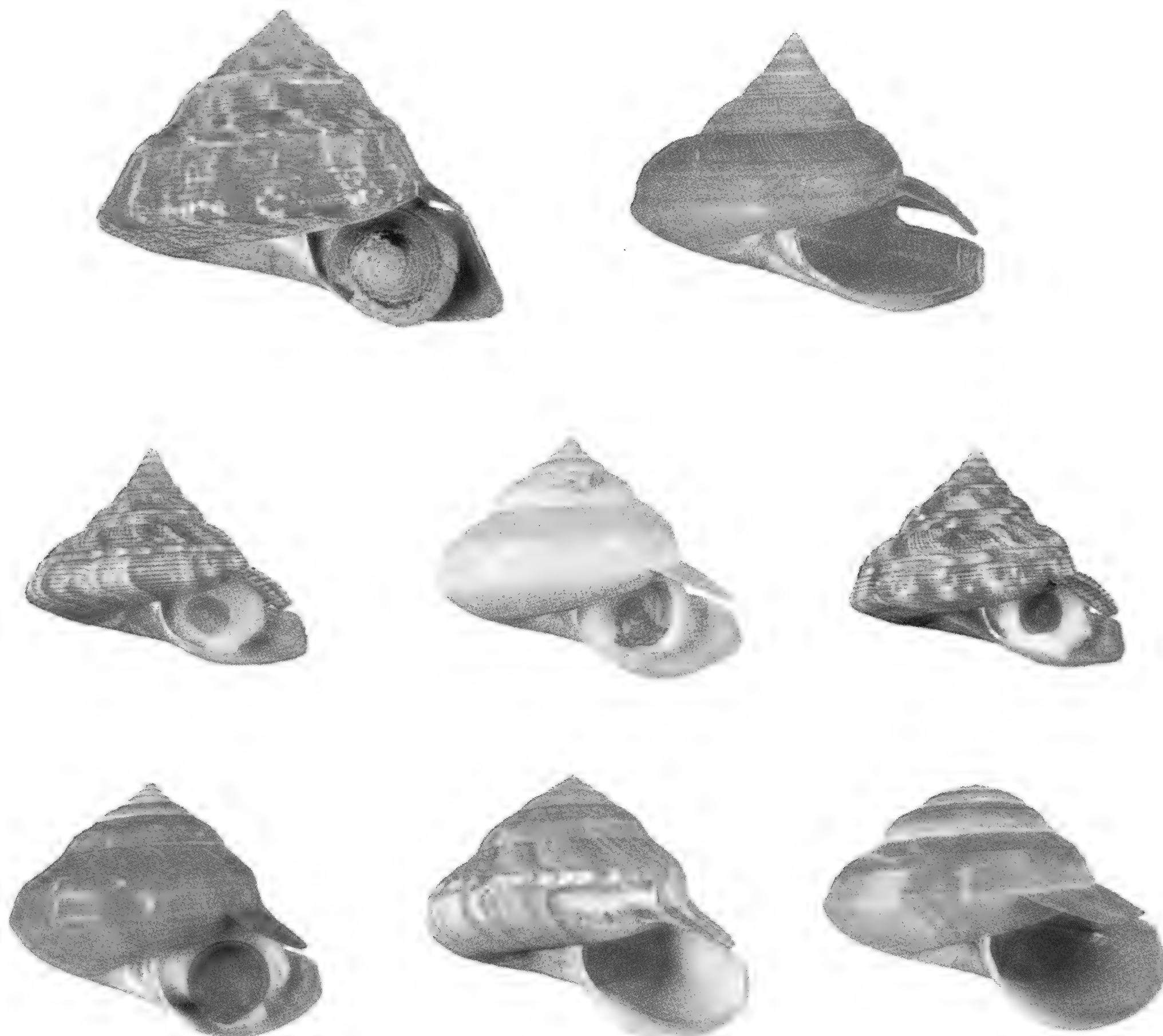
Since I first started collecting shells my favorite shell has been the magnificent Catalina Trophon (sometimes called a Forreria), *Austrotrophon catalinensis* (Oldroyd, 1927).

All of the old literature called the shell “uncommon just off shore” and sometimes found on the shore! Clearly this was not the case, although a few dead specimens have rarely been found on the shore, most known specimens have been dredged from moderate depths (40-70 m). Most specimens were taken by the Oldroyds’ themselves, or commercial fishermen in the early 1900’s, and at one time there was a sizable population off of San Pedro, California. but since trawling off southern California many years ago, the shell is now extremely rare, and nice specimens are even rarer! Even annual surveys by many local and national agencies very rarely encounter it. In the early 80’s I acquired several specimens from an old collection, all of these have long since been sold or traded away. In 1988 while working on the chiton collection at the Natural History Museum of Los Angeles County, California, I received a large, magnificent specimen from Dr. James H. McLean in exchange for some recently acquired and very rare Russian gastropods. The shell was the prize of my collection for many years. Then in the early 2000’s, while 6 feet up in the back of a tray in a cabinet in my garage, the shell vanished without a trace! To this day I have no idea how or even really when it disappeared and no plausible scenario. It would be many years before I acquired another.



In May of 2014 while visiting my friends Glenn and Laura Burghardt at their home in northern California, they gifted me a wonderful little specimen, with a very interesting history (see photo above). The specimen is relatively small for the species (which can reach 100+ mm in length), at 67.7 mm in length, but has wonderful development, with the spines spreading to 60.4 mm! The shell is very nice, and in natural (uncleaned) condition.

The shell was received in the 1960’s from Allyn G. Smith at the California Academy of Sciences, while Mr. Burghardt was working at the Academy’s Steinhart Aquarium. The specimen was said to have come from the collection of Josiah Keep (author of the book “West Coast Shells”, however this not the specimen illustrated in that book), and was collected by Dr. R. H. Tremper a well-known collector in the early 1900’s for whom the white banded *Pteropurpura macroptera* var. *tremperi* Dall, 1910 and *Cymatium corrugatum* var. *tremperi* Dall, 1907 [now recognized as *Monoplex amictus* (Reeve, 1844)] was named. The shell has a long and unique history, and that is what makes it special to me. I am grateful to Glenn & Laura Burghardt for the gift of this magnificent shell.



E. adansonianus adansonianus (Crosse & Fischer, 1861), Bahamas, 106.1 mm. *B. poppei* (Anseeuw, 2003), Tonga Islands, 58.8 mm. *P. amabilis f. maureri* Harasewych & Askew, 1993, USA, 42 mm. *B. tangaroana* (Bouchet & Métivier, 1982), New Zealand, 55.9 mm. *P. quoyanus* (Fischer & Bernardi, 1856), Curaçao, 50.7 mm. *B. philpoppei* Poppe, Anseeuw & Goto, 2006, Philippines, 65.1 mm. *B. charlestonensis* Askew, 1987, Martinique, 77.3 mm. *B. midas* (Bayer, 1965), Bahamas, 82.7 mm.

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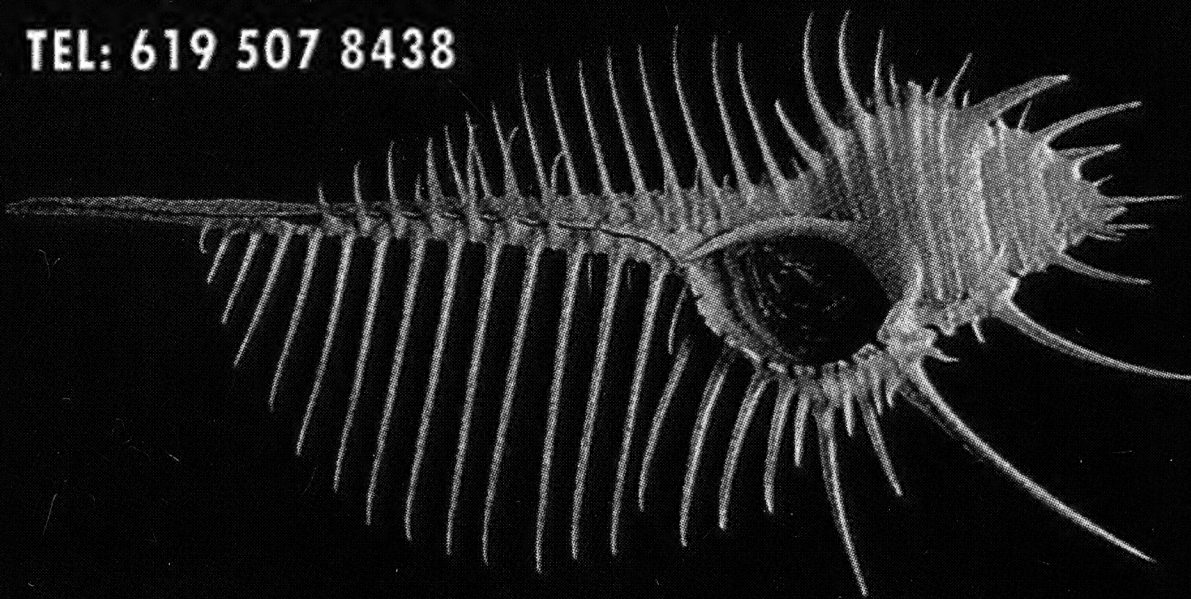
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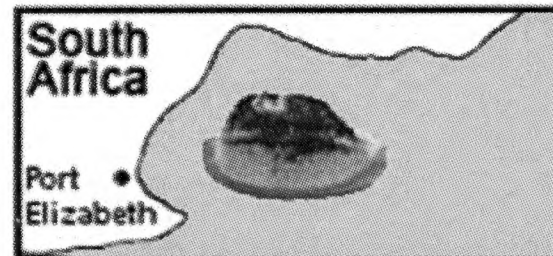
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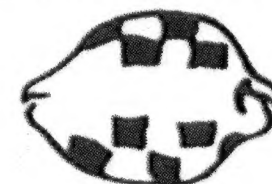
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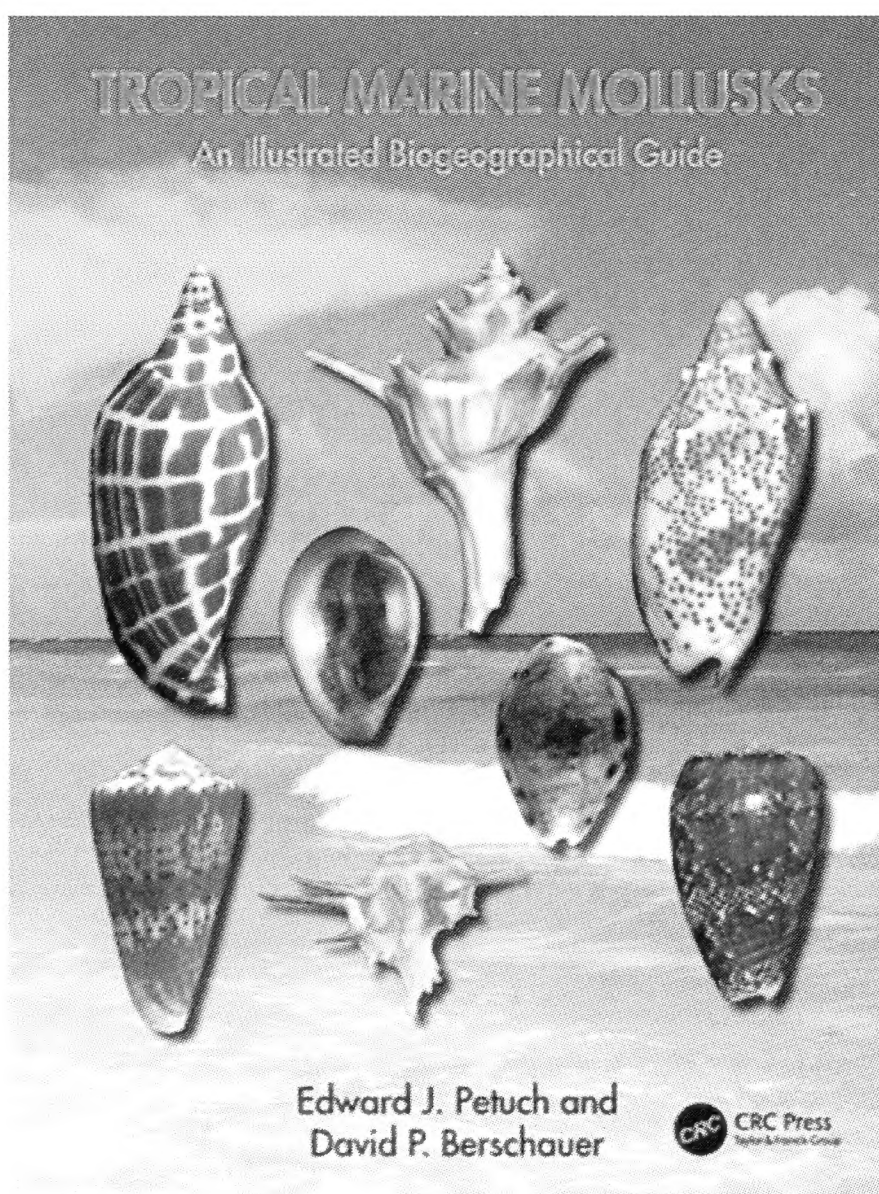
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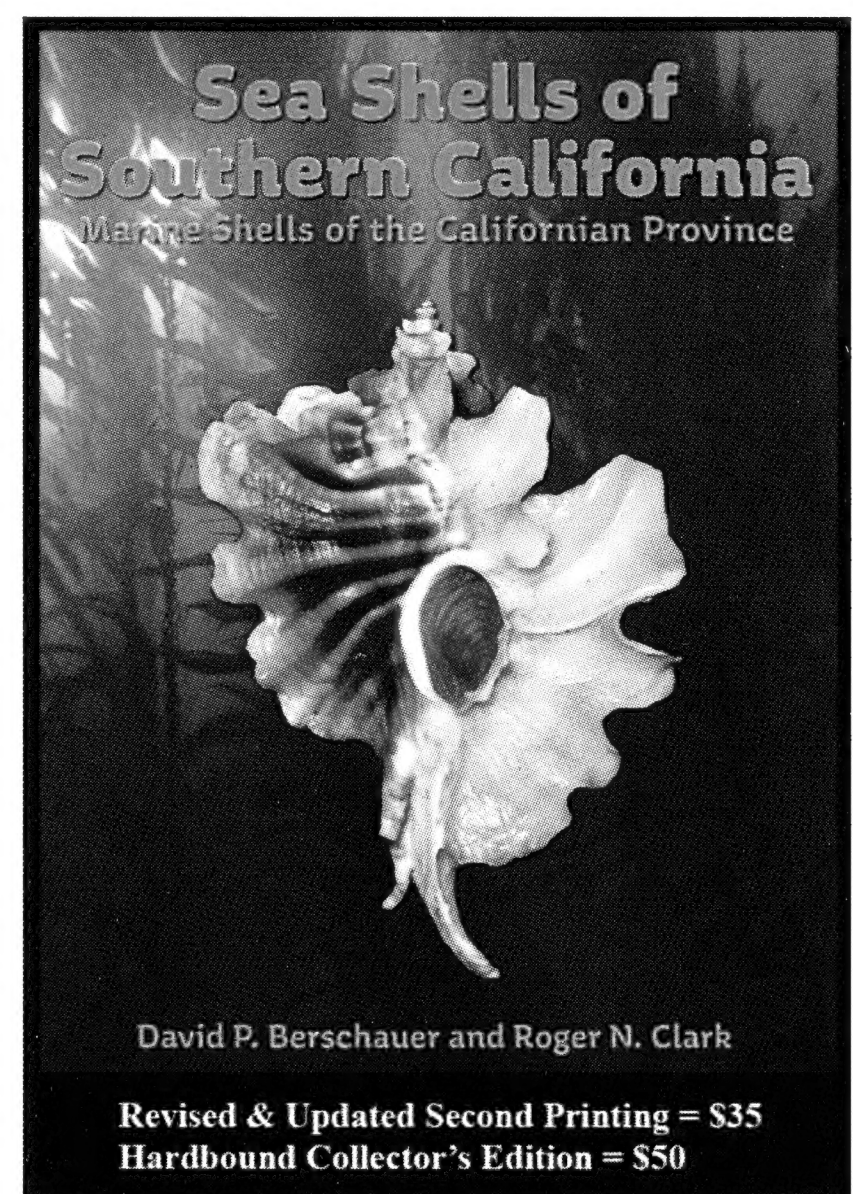


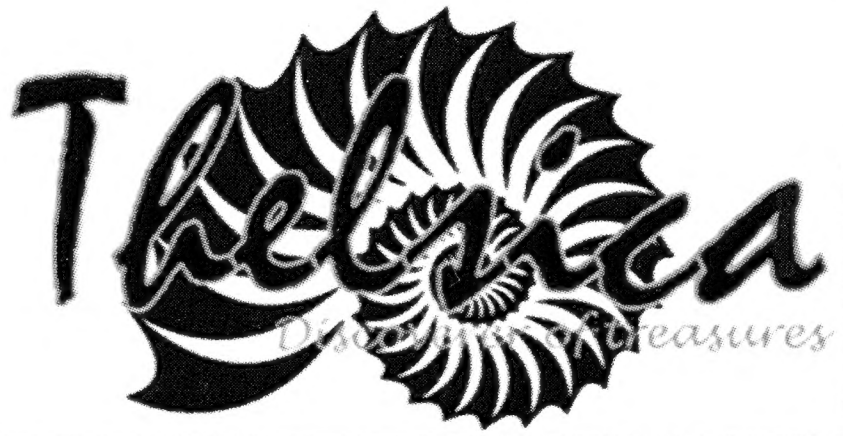
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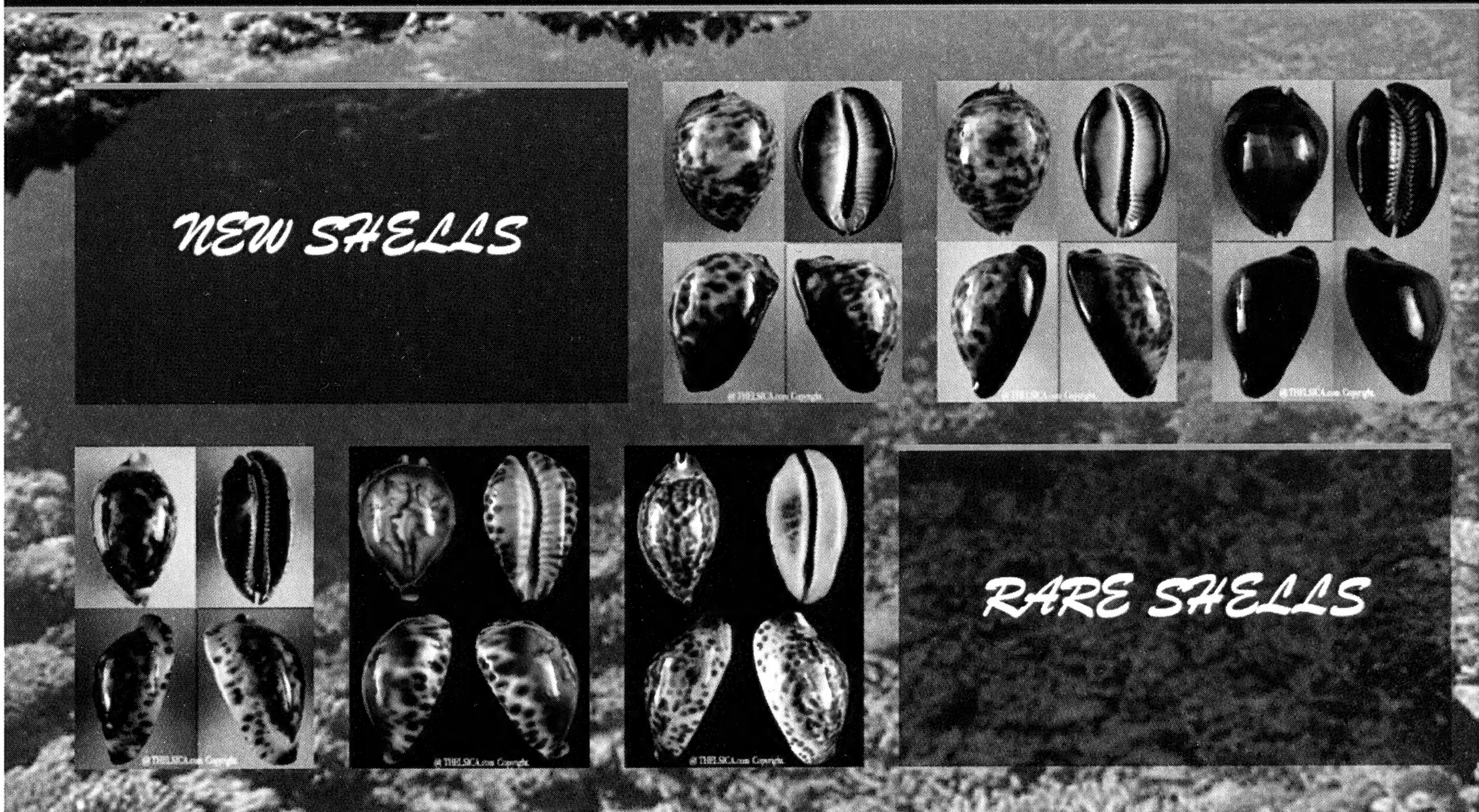



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